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ABSTRACT

This booklet is part of a series designed to help students take and defend a position on public issues. This booklet addresses the issues faced by society and individuals due to advances in scientific knowledge. It presents questions, stories, and scenarios for student discussion. Students are instructed to identify three kinds of questions in a discussion: (1) ethical or value questions; (2) questions of definition; and (3) questions involving facts and explanation. The document consists of six sections. The first is an overview that introduces the series, explains to students what the issues to be examined are, and suggests how the student should approach these issues. The second section deals with society and the limits that it places on science. As illustrations of the power of society to repress scientific knowledge, this section discusses the trial of Galileo and the modern example of the cancellation of funding for a conference on possible links between genetics and violence. The third section describes the dilemma faced by scientists when society disapproves of or condemns as evil their methods or studies. The next section is on specialized knowledge and decision making. It presents scenarios of debates over the fluoridation of water and how much information physicians may withhold from patients or their families. The fifth section relates these issues to current topics and choices about creating and using knowledge. The final section presents questions for review and discusses the issue of choices and of who funds what research. The accompanying teacher's guide focuses on the following organizing questions: (1) Under what conditions, if any, would it be in the public interest to prohibit or limit certain lines of investigation, to keep investigations secret, or to prevent a person from disseminating a scientific belief? (2) Under what conditions, if any, might a scientist's obligations to her profession conflict with obligations to her country or to humanity? How should these dilemmas be resolved? and (3) What is the citizen's obligation to understand science? What kinds of public policy questions should citizens delegate to scientists and experts? The guide breaks down teaching the unit into preparation, introduction of the unit, and a basic discussion of each section of the unit. A 6-item bibliography and handouts are included. (DK)

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Uses and Control of Knowledge

Public Issues Series
Social Science Education Consortium

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Public Issues Series

Science and Public Policy: Uses and Control of Knowledge

Adapted from the Harvard Social Studies Project
by Laurel R. Singleton
under the direction of
Donald W. Oliver and Fred M. Newmann

Contents

Introduction 3
What Is the Public Issues Series? 3
What Are the Central Issues of This Unit? 3
How Will We Approach the Issues in This Unit? 4
Society and Limits on Science 6
The Trial of Galileo 6
Biology and Behavior: The Debate on Violence 16
The Scientist's Dilemma 23
Oppenheimer: Scientist Accused 23
Should Nazi Data Be Used? 36
Specialized Knowledge and Decision Making 41
A Fight Over Fluoridation 41
Doctors, Patients, and Decisions About Treatment . . . 54
Today's Issues 61
Choices About Creating and Using Knowledge 61
Review, Reflection, and Research 65

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What Is the Public Issues Series?

The Public Issues Series is designed to help you take and defend a position on public issues. A public issue is a question involving a choice over which there is disagreement. Public issues can be answered by all the citizens of a nation or community or by officials acting for them:

- Should a nuclear facility be authorized to increase its capacity for storage of radioactive waste?

Public issues can also be phrased as choices for personal action:

- Should I participate in a rally to protest the shipping of radioactive waste through my city?

You might ask why this unit looks at historical issues related to science and public policy rather than concentrating just on current issues. By looking at how decisions were made in the past, we can see that history did not have to happen just the way it did. History is not simply a rushing stream of political, economic, and social events. The decisions people make shape history. In addition, many of the problems people face persist across time and place. By looking at how these conflicts were resolved in other times and places, we can clarify our positions on how they ought to be resolved here and now.

What Are the Central Issues of This Unit?

Today's political leaders and citizens face many decisions that involve science and technology: How, if at all, can radioactive waste be safely disposed of? To what extent is global warming a problem and what should be done about it? Should hundreds of thousands of dollars worth of medical care be provided a newborn baby with little or no chance of living a "normal" life? How can we balance the need for economic development with the need to maintain biological diversity?

For many years, the relationship between public policy and science and technology was much less evident. Although early presidents, including Thomas Jefferson and John Quincy Adams, called for a national effort in science, not until World War II did the federal government participate on a large scale in the development of science and technology. President Franklin D. Roosevelt was fascinated by the output of scientists during wartime. He asked the head of the U.S. war effort in science to decide how research techniques growing out of the war "should be

used in the days of peace ahead for the improvement of the national health, the creation of new enterprises, bringing new jobs, and the betterment of the national standard of living." Roosevelt's directive eventually led to the establishment of the National Science Foundation in 1950. Since then, government expenditures on science have skyrocketed.

Roosevelt's vision of science and technology bringing untold benefits to humans was—and is—shared by many. These advocates see science curing disease, lengthening the life-span, and giving humans more control over the environment. Others suggest more gloomy consequences: industrial processes that pollute the environment, weapons that can destroy the human race, and biochemical discoveries that could permit control of human thought.

This book cannot provide firm answers to the many problems of science and public policy, but it does confront crucial issues:

- Under what conditions, if any, would it be in the public interest to prohibit or limit certain lines of scientific investigation, to keep investigation secret, or to prevent a person from disseminating a scientific belief?
- Under what conditions, if any, might a scientist's obligations to his/her profession conflict with obligations to his/her country or to humankind? How should these dilemmas be resolved?
- What is the citizen's obligation to understand science? What kinds of public policy decisions, if any, should citizens delegate to scientists and experts?

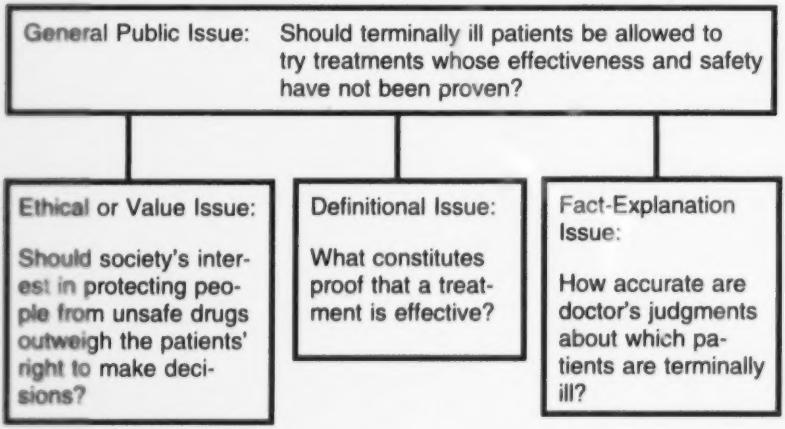
How Will We Approach the Issues in This Unit?

This unit asks you to take part in many discussions. Remember that not every discussion will resolve disagreements. It is often just as useful for people to learn to state their ideas with more precision and clarity and to discover precisely how their ideas differ from those of others.

Learning to identify the kinds of questions being raised can help keep discussion moving. In discussing public issues, people generally look at three kinds of questions:

- Ethical or value questions. These questions deal with judgments about what should or ought to be done—judgments about rightness and wrongness.
- Questions of definition. These questions revolve around the meaning of important words or phrases.
- Questions involving facts and explanation. These questions focus on disagreements about the descriptions or explanations of events.

Examples of each kind of question are given in the diagram below.


General Public Issue: Should terminally ill patients be allowed to try treatments whose effectiveness and safety have not been proven?
Ethical or Value Issue: Should society's interest in protecting people from unsafe drugs outweigh the patients' right to make decisions?
Definitional Issue: What constitutes proof that a treatment is effective?
Fact-Explanation Issue: How accurate are doctor's judgments about which patients are terminally ill?

You may be starting to see that dealing with public issues involves thinking on several levels at the same time:

- Thinking about the controversial topic at hand.
- Thinking about the process of clarifying the topic by identifying the kinds of questions being raised and using strategies for dealing with them.
- Thinking about the feelings and relationships we develop toward others in the conversation and how we can deal constructively with these feelings.

Remember that the reason for discussing a public issue is not to "win" the argument but to understand more clearly your own views and the reasons that support them, as well as differing opinions.

The Trial of Galileo

In 1992, Galileo Galilei, a scientist who died more than 300 years before, made news. Why? The Roman Catholic Church finally decided it had been wrong to condemn Galileo for arguing against church-taught beliefs about the universe.

Galileo's theories of the universe and his belief that knowledge could be gained through direct empirical observation alarmed earlier Church officials. Galileo's challenge to Church doctrine led to his trial before the Inquisition, a series of church inquiries into proper beliefs.

As you read the account of the trial that follows, think about the Church's reasons for charging Galileo. Would you have supported the Church in prohibiting the publication of Galileo's book? If you had been Galileo, would you have recanted your beliefs?

* * * * *

Galileo's Early Investigations

Mechanical motion fascinated Galileo Galilei. At the age of 17, intrigued by the swinging of a lamp in a cathedral, he discovered the law governing the movement of pendulums. In his 20s, he went on to investigate gravity. By dropping two unequal weights (allegedly from the Leaning Tower of Pisa), he disproved the claim of the Greek philosopher Aristotle that weight governs the velocity of falling bodies.

Galileo's investigations caused him to question cherished beliefs. The Roman Catholic Church issued doctrine not only on questions of proper moral and religious conduct but also on the physical nature of the universe. For example, the Church accepted the view of Claudius Ptolemy—an ancient Greek astronomer—that the Earth was the unmoving center of the universe. When the Polish astronomer Nicolaus Copernicus published a work in 1543 suggesting that the planets revolved around the sun, the Church rejected the idea.

The Ptolemaic view was consistent with the religious notion that man and Earth were the *special* focus of God's creation and attention. The Copernican view suggested that the sun shone on several other planets as well, that all planets were "equal" in the sense of rotating around and depending upon the sun. This was considered a direct attack on man's unique and privileged position in God's eyes.

Galileo himself agreed with Copernicus. Yet he kept his opinion secret to avoid trouble. Such caution helped him advance as an astronomer, and he was hired in 1609 by the great Duke of Tuscany.

Among the first in Europe to make a telescope, Galileo soon gathered new evidence to support the Copernican view. Jupiter, he learned, was circled by four satellites. Venus passed through cycles like those of the moon. Finally, he detected spots on the sun that moved and changed shape. Such observations, when combined with certain mathematical calculations, seemed to bolster the theories of Copernicus, rather than those of Ptolemy.

Five years passed before Galileo's report on sunspots aroused the concern of the Holy Office of the Inquisition—an arm of the Church for the detection and punishment of heretics, people who dissented from Church doctrines. A committee appointed by the Pope ruled that Galileo's support of Copernican theories went against the true faith.

According to the Vatican files, the Pope in 1616 then "directed the Lord Cardinal Bellarmine to summon before him the said Galileo and warn him to abandon the said opinion; and in case of his refusal to obey, the Commissary is to deliver to him, before a notary and witnesses, a command to abstain altogether from teaching or defending this opinion and doctrine, and even from discussing it; and if he does not agree, he is to be imprisoned."

Galileo agreed to change his opinion. However, the way was still open for him to discuss Copernican theory in a general way so long as he showed no "refusal to obey." It seemed that Church authorities would now be satisfied and that he would still enjoy considerable freedom in his work.

Questions for Conversation

1. How did the theories of Copernicas differ from those of Ptolemy? Why were these differences so important to the Catholic Church?

2. Describe the warning the Church gave Galileo in 1616. After this warning, how free do you think Galileo was to pursue his work?

Dialogue on the Great World Systems

Eight years later, Galileo returned to Rome and discussed Copernican theory with Urban VIII, a new Pope. The apparent calmness with which the Pope listened led Galileo to believe that he could publish his views freely. He went ahead with a book, the *Dialogue on the Great World Systems*, which he completed in December 1629.

This book took the form of a discussion among three people—one supporting Ptolemy, one supporting Copernicus, and one with an open mind. Despite the fictional framework, the drift of Galileo's book was clear. The fellow supporting Copernicus stated the most persuasive arguments. The defender of the Ptolemaic system—pointedly named Simplicio—did poorly in the "debate." In fact, Simplicio's statements echoed arguments made publicly by Pope Urban himself.

What might have seemed to some people an objective philosophical discussion appeared to the Pope as a personal attack tinged with ridicule.

Although the book had been approved by Church authorities in Rome and Florence before publication in 1632, the Vatican ordered the publisher to stop selling the book. A committee of theologians and mathematicians was called to investigate the matter. They came across a strange document in the Vatican files—one that contradicted other accounts of Galileo's 1616 meeting with Cardinal Bellarmine. It reported:

> Friday, the 26th—At the palace, the usual residence of the Lord Cardinal Bellarmine, the said Galileo having been summoned and brought before the said Cardinal, was, in presence of the Most Reverend Michael Angelo Segnezzio, of the order of preachers, Commissary General of the Holy Office, by the said Cardinal warned of the error of the aforesaid opinion, and admonished to abandon it; and immediately thereafter before me and before witnesses, the Lord Cardinal Bellarmine being still present, the said Galileo was by the said Commissary commanded and enjoined, in the name of His Holiness the Pope, and the whole Congregation of the Holy Office, to relinquish altogether the said opinion that the sun is the center of the world and immovable

> and that the earth moves; nor henceforth to hold, teach, or defend it in any way whatsoever...

This report of Galileo's meeting with Cardinal Bellarmine makes the restrictions on Galileo sound more severe than do other accounts of the meeting. Some people believe that a minor Church official drew it up and filed it in 1616 expressly for use as a curb on the scientist if he became troublesome. In any case, the document gave Galileo's critics the opening they needed to charge him with defying Church authority.

When summoned to Rome for a trial on charges of heresy, Galileo was old and ailing. Three doctors certified that he was suffering from a hernia, fluttering heartbeat, stomach trouble, insomnia, and assorted pains. Nevertheless, he was ordered to Rome—though it was granted that he could travel slowly.

At the start of the trial, Galileo still had not been given formal notice of the charges against him. Testimony went as follows:

Tuesday, April 12, 1633*

Galileo of Florence, son of the late Vincenzio Galilei, aged 70, having been requested to swear to speak the truth, took the oath by touching the holy objects.

Q: Does he know, or can he imagine, for what reason he was summoned?

A: I imagine that I was ordered to present myself before the Holy Office in Rome to give an account of my recently published book; and my reason for supposing this is that an order was issued to me and my bookseller a few days before I was summoned to Rome, prohibiting us from circulating any further copies of the book...

After answering questions about the writing of his book, Galileo was asked to recall the nature of the Church's warnings in 1616 concerning his handling of Copernican theories:

A: I remember that his [Cardinal Bellarmine's] instructions were that I should neither hold nor defend, and it may be that he added that I should not teach, the aforesaid views. I do not remember that he did so,

*The dialogue following is from *Man on Trial*, by Gerald Dickler. Copyright 1962 by Gerald Dickler. Reprinted by permission of Doubleday and Company, Inc.

nor do I remember the qualifications in any way.... A few months later I received from Cardinal Bellarmine the document which I have presented here, and in which is set down the order not to hold or defend the said opinion. And I have no recollection of the other phrase which you now bring to my attention—namely, *and not to teach in any way*—no doubt for the reason that it is not stated in the written document which has served me as a memorandum.

At the end of this hearing, Galileo was confined to a room in the Palace of the Inquisition and ordered to be silent about the proceedings.

Repeatedly in later testimony, Galileo expressed regret for anything in his writing that might be interpreted as a violation of the Church's orders.

Questions for Conversation

1. Why was Pope Urban VIII especially angered by the *Dialogue on the Great World Systems*? Do you think his anger was justified? Why or why not?

2. What were the key differences in the two accounts of the Church's warning to Galileo in 1616? Why were these differences important? Can differences in factual accounts be resolved to the satisfaction of both parties in disputes where one party seems to have all the power? Why or why not?

Galileo's Final Testimony

On June 21, 1633, after ten weeks of questioning, Galileo came before the judges of the Inquisition and a large group of Church officials for a final examination of his beliefs. His responses took on special urgency because he knew he was testifying under threat of torture. Excerpts from the testimony follow:

Q: Does he hold, or has he ever held, the opinion that the center of the universe lies in the sun, and the earth is not the center of the universe, and that the earth moves with a diurnal motion; and if so, since when has he so held?

A: Already for a long time before the decision of the Holy Congregation of the Index, and before any directive was given, I considered both the opinion of Ptolemy and that of Copernicus, indifferently, to be disputable; for either the one or the other might be true in nature. But, follow-

ing the aforesaid decision, confirmed by the wisdom of the authorities, all ambiguity ceased for me and I held, as still I do hold, as true and indubitable, Ptolemy's view, namely, that the earth is motionless and the sun in motion.

Q: And it was said to him that this [Copernican] view was discussed and defended in the book published at the time stated above, as appears from the language and tenor of the book itself; and that, indeed, it might be assumed from what he wrote and published in that book that he had continued to embrace that view after the time in question. Therefore, let him freely say whether he holds or ever held it to be the truth.

A: With regard to the writing of my published *Dialogue*, I did not undertake it because I hold Copernicus' view to be true, but rather solely for the general good, in order to set forth the natural and astronomic arguments that might be advanced on either side, and in an effort to make manifest that none of these had power to conclude affirmatively either for the one or for the other view....

Q: And it was said to him that it truly appears from the reasons and positive statements brought forward in his book that he assumes the earth to be in motion and the sun stationary; so that it was thought that he had, at least for a time, embraced the views of Copernicus. Therefore, unless he decides to speak the truth, the instruments of the law as befitting the situation will be employed against him.

A: I do not hold the view of Copernicus, nor have I held it since I was prompted and instructed to abandon it; for the rest, I am here in your hands, let you do with me as you will.

The sentence was pronounced on the following day:

> Whereas you, Galileo, son of the late Vincenzio Galilei, of Florence, aged 70 years, were denounced, in 1615, to this Holy Office for holding as true a false doctrine taught by many; namely, that the sun is immovable in the center of the world, and that the earth moves...

Then, after cataloging at length ways in which Galileo's writing could be seen as a defense of the Copernican system, the sentence referred to his failure to heed the alleged warning years before. The sentence denounced Galileo's most recent book in strong terms and then explained the gravity of the charges made against the scientist:

> We pronounce, judge, and declare, that you, the said Galileo, by reason of these things which have been detailed in the course of this writing, and which, as above, you have confessed, have rendered yourself vehemently suspected by this Holy Office of heresy; that is, of having believed and held the doctrine (which is false and contrary to the Holy and Divine Scriptures) that the sun is the center of the world, and that it does not move from east to west, and that the earth does move, and is not the center of the world....
>
> We condemn you to the formal prison of this Holy Office for a period determinable at Our pleasure; and by way of salutary penance, we order you during the next three years to recite, once a week, the seven penitential psalms, reserving to ourselves the power of moderating, commuting, or taking off, the whole or part of the said punishment or penance.

But Galileo faced a final humiliation. He was forced to kneel before the Inquisition and recant his Copernican views. He promised not only to abandon his support of Copernican theory and to avoid any statements that might lead people to think he favored the view of Copernicus. He also promised to denounce anyone he suspected of heresy. Finally, he agreed to fulfill any penances the court laid upon him.

On July 6, Galileo was allowed to leave Rome, ending an ordeal of almost five months.

Questions for Conversation

1. What promises did Galileo make at the end of the trial? Do you think he was sincere in his promises or did he renounce his views for self-protection? Do you think he was justified in doing so?

2. Would you support or oppose the action of the Church in prohibiting the publication of Galileo's book and forcing him to recant his beliefs? What arguments can be made on both sides of this issue? Which arguments do you find most compelling?

Persisting Questions of History

Considering Analogies. Review your position on Galileo's case. Then consider how the following two cases are similar to and different from Galileo's case.

a. Ten-year-old Dave Robertson, known in the neighborhood for his independent thinking, decided one year that kids should be told the truth about Santa Claus. The 15 younger kids on the block (between the ages of one and five) were looking forward to visiting Santa Claus at the mall and to receiving gifts from him on Christmas Day. All the kids were invited to a birthday party for Dave's three-year-old brother, Johnny, early in December. At the party, Dave called the kids together for a "story" and explained in a serious tone that there was no real Santa Claus and never had been. He told how men dressed in costumes to lure kids and parents into shopping malls and how parents bought and delivered the kids' gifts. Several of the youngsters became quite disturbed and went home crying. Dave's mother received a number of indignant phone calls, accusing Dave of destroying the holiday spirit and of undermining the children's faith in their parents' word. They demanded that the Robertsons stop Dave from spreading the word about Santa Claus. Dave refused to stop his preaching. "I'm only telling the truth," he argued. "What harm can that do?"

b. Hiram Lansing was a respected research physicist at the Electron Corporation's laboratory. Several years after he started with Electron, he began having unusual experiences. He heard strange voices—vaguely at first, but later much more clearly. The voices were transmitted from outer space. They presented information about the Nerve Center of the Universe. The Center was a fantastic force—a source of energy, power, and intelligence far beyond human imagination. It controlled all life on earth, all elements in the universe. The voices explained that Hiram had been chosen, quite by chance, to be a human receiver of the truth about the universe.

   Part of the truth was that there was no such thing as the real world, though people thought there was. The Center had simply communicated to people various kinds of information and senses (touch, taste, vision, hearing, smell). The Center could make people believe that there was a real world, that there were other people, that there were certain right and wrong ways of living. It could even make people believe in a god or in many gods. The important point

was that humans had no beliefs or opinions or will of their own—everything was an illusion created by the Center.

For a while, Hiram couldn't believe the voices. He had been accustomed to careful scientific study, and he didn't believe in miracles or magic. Yet, inside, he felt a gnawing torture and anguish. Finally, he did accept these messages as truth and he felt much better. He spoke of these ideas to astonished relatives, friends, and colleagues. Other scientists at Electron brushed him off at first, thinking he just needed a vacation.

Hiram looked for concrete evidence to prove his point to the scientists, but evidence was hard to come by, except for the voices. Physicists admitted that earth did receive radio signals of various sorts from outer space. Hiram suggested that humans just hadn't yet discovered how to interpret the rays and waves; if they could, it would prove the voices were accurate. Scientists were not convinced, but they began to think and talk.

Hiram became so involved and enthusiastic about the theory that he could discuss nothing else. Word about Hiram's "voices" spread through the community. Phone calls from pranksters calling Hiram a "nut"; complaints from parents who said his children's discussion of his ideas were disrupting the instructional process of the school; letters to the editor in the local paper urging that such individuals be given medical care—all of this upset the Lansing family. Hiram's wife Liz began to worry quite seriously. She hated to admit it, but deep down inside, she felt her husband needed the attention of a psychiatrist—he must be mentally ill.

Hiram refused to discuss the possibility that he needed psychiatric help. Finally, Liz started the action necessary to have Hiram committed to a mental clinic. Hiram protested, but the doctor explained that he would be given the best of care; that people were there to help him; and that as soon as his beliefs about the Nerve Center were dispelled, he could return to a normal life with his family.

Hiram tried to make the best of the first week in the clinic. He enjoyed telling the other patients about the Center. After the first week, however, Hiram wanted most desperately to return to his family and his job. Yet he still saw no reason to reject notions as exciting and convincing as the ones he held. After all, no one had been able to prove him wrong.

Meanwhile, his family remained bewildered. But one thing his wife was sure of—he should not be released until cured.

Do you think Dave Robertson or Hiram Lansing should be discouraged from spreading their theories? If Dave continues to do so, do you think some action should be taken to punish or censure him? Do you support confining Hiram to a mental hospital? Justify your opinions.

Protecting the Individual or Society. It could be argued that Hiram Lansing was confined to a mental institution primarily for his own good; that is, to cure him so he could function better in life. Galileo, however, was censored not for the sake of his own health, but because he posed a danger or threat to society. Do you think this is an important difference between the two cases? Discuss similarities and differences of other situations in which a person's freedom is restricted primarily for the purpose of (a) improving him/herself or (b) protecting the welfare of society. Examples to consider: sentencing a convicted murderer to imprisonment for life; requiring youth to attend school; disciplining a student for cheating; prohibiting the sale of obscene books; quarantining diseased people.

How Honest Should a Person Be? Suppose that all along Galileo really did believe the Copernican theory (that the earth revolved around the sun) and that his denials of such beliefs to the Church were deliberate lies. Suppose also that when Hiram Lansing realized that he was being confined to a mental hospital, he decided that, although he still held his views about the Center, it would be better to lie to the authorities in order to get out of the hospital. He could tell the doctors that he never really believed in the theory, but was merely testing the reactions of the community to the new ideas he had advanced.

Would Galileo and Hiram be morally justified in lying? Why or why not?

Biology and Behavior: The Debate on Violence*

Even if the National Institutes of Health had been hunting for controversy, it couldn't have chosen an issue more prickly than the subject of its scheduled conference last October: "Genetic Factors in Crime: Findings, Uses and Implications." The conference never occurred. The NIH withdrew more than $78,000 in funding for the University of Maryland meeting, which drew charges of racism and evoked debate over academic freedom and scientific responsibility.

As you read about the controversy provoked by the conference, think about how you would have decided had you been given the power to determine whether the conference was held or canceled. Look for arguments to support your views.

* * * * *

Genetic or Environmental?

Much of the uproar about the conference came after Dr. Fred Goodwin, then head of the Alcohol, Drug Abuse, and Mental Health Administration, compared inner city youth to monkeys. "Maybe it isn't just the careless use of the word when people call certain areas of certain cities jungles," said Goodwin, who lost his job because of his remarks.

The controversy is the latest in a conflict over the link between biology and behavior. Many scientists agree that a link exists, but its magnitude is unknown: A genetic factor may be a small piece of an individual's biological, psychological, and sociological baggage.

The link between violence and genetics is weak at best, said Gregory Carey, associate professor of behavior genetics at the University of Colorado. Research has not yielded a genetic marker for crime, but statistical studies suggest that the roots of crime may be biological.

A 1984 study looked at the criminal patterns of adopted boys and their biological parents in Denmark. Researchers found that adopted children who committed crimes against property, such as stealing and vandalism, most often had biological parents who were convicted of similar crimes.

Excerpted from "Genetic or Environmental? The Debate on Violence Continues to Rage," by Evaleen Hu, Boulder Daily Camera (February 25, 1993), pp. C1-C2.

Most violence studies have been done in Scandinavian countries, which keep national registries of crimes, adoptions, and twins. But the relative homogeneity of these countries makes many scientists skeptical of applying these findings to the United States, where racial and socio-economic differences run deeper.

Complex Questions and Flawed Studies

The science community is wary. Many studies that have tried to find a "crime gene" have been muddled and inaccurate. In the 1920s and '30s, eugenicists, with the support of some scientists and government officials, urged sterilization of immigrant groups to prevent "flawed" genes from entering the gene pool. And in the 1970s, one study suggested that individuals with XYY chromosomes were more prone to crime that those with XY chromosomes.

Paul Billings, chief of the Division of Genetic Medicine at the Pacific Medical Center in San Francisco, warned: "In the '20s and '30s, there was the rise of the biological quick fix, using discoveries in the biological sciences to explain social problems. Using social engineering with a biological explanation has as many problems as social change... Some of the same kind of eugenic decisions are being made today."

Even established studies correlating behaviors such as alcoholism and schizophrenia to biology have come under scrutiny for findings that couldn't be duplicated.

Geneticists suggest that if anything results from violence studies, it won't be as simplistic as eugenics research once was. Violence, for example, may be diffused throughout several genes, or the roots of crime may be chemical. Recent studies have suggested that criminals may have chemical imbalances.

At this point, "We can't genetically identify someone who's going to be a violent criminal," Carey said. "The probability we will get there is science fiction. What we'll end up with is a vague predictor." For example, statistics show that men are more likely to be violent than women. But that doesn't mean all men are violent.

Opposing Views on Violence Research

Many researchers aren't letting public outcry stop their work, despite misperceptions that they are targeting African-Americans or are trying to control aggressive children through drug therapy.

"I was surprised and disturbed that the conference was canceled," said John Fischer, professor of philosophy at the University of California at Riverside, who was scheduled to speak. "There's nothing wrong with doing the research...You just don't preempt the research because you're afraid it is inappropriate."

"I'm concerned about the fact that the NIMH had to...say it wasn't going to fund any projects," said Patricia Brennan, a research assistant who worked on the Danish adoption studies. "To make that statement is to say that politics can say what can be funded. But I'm going to continue to pursue what I'm interested in pursuing."

Future research needs a more consistent definition of crime and violence, scientists agree. Existing studies don't clearly differentiate between such acts as embezzlement, child abuse, and stealing towels from a hotel room.

"The studies leave out significant parts of the population," said Robert Murray, a medical geneticist at Howard University. "Men and women get paid large amounts of money to be violent—football players, wrestlers, boxers...You have to consider that these are violent people as well."

As biology and behavior move closer together, controversy will follow. Genetic research is becoming more sophisticated, and scientists predict it will raise more questions than it will answer. "When the Human Genome Project [a project to map the 100,000 human genes] is over, we will have located every gene and will know its sequence," Billings said. "People will have that genetic knowledge but won't know what to do with it. There will be lots of discrimination, and much of that will be adverse."

19

Persisting Questions of History

Taking a Position. Would you have withdrawn funding for the conference on "Genetic Factors in Crime" ? Would you continue funding for research projects exploring the relationship between genetics and violence? Support your decisions.

Would your response be different if the planned conference were on "Genetic Factors and Homosexuality"? Consider the following opposing views in making your decision:

- If homosexuality is genetic, people who now think homosexuality is a sin may become more tolerant and accepting.
- If homosexuality is genetic, some parents may abort fetuses that prenatal testing has revealed are homosexual.

The Scientist's Responsibility. Scientist Paul Billings anticipates that genetic knowledge will result in discrimination. For example, insurance companies already discriminate against people with defective genes linked to diseases requiring expensive medical care. Some people fear that pregnant women whose babies carry a gene for violence might be pressured to have abortions. If the gene is more common among certain groups of people, the result could be seen as genocide.

Put yourself in the place of a scientist who anticipates that your research could lead to "adverse discrimination." What action would you take? Would you oppose continued research in areas that would have such effects? Would you support continued research but demand that the agencies funding the research undertake education efforts to counteract the negative effects of scientific knowledge? Develop a statement to be presented at a congressional hearing on funding for research on genetics and violence.

Which was more important to you in reaching a decision—your obligations as a scientist or your obligations as a citizen and human being? Explain your answer.

Defining Violence. Scientists have agreed that a better definition of *violence* is needed. With a small group of classmates, develop a definition on which you can all agree. How might use of your definition influence the way in which research is conducted or how the results of research are viewed by the public?

Politics and Science. The quotation from Patricia Brennan suggests that politics should not influence what scientific research is funded. Do you agree or disagree? What definition of *politics* are you using in making your decision? If you defined *politics* differently, might you change your answer?

Read the following case. Does it affect your thinking about the influence of politics on science? How did politics contribute to the problems with the scientific research described? How might politics help contribute to their solution? Overall, do you think this case argues for more or less political influence on science? Why?

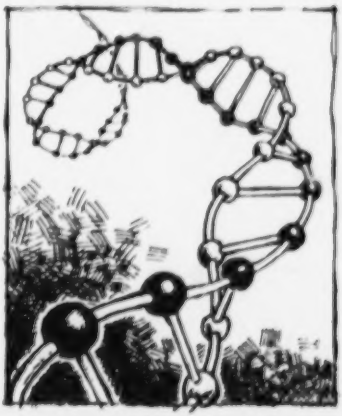
On June 18, 1990, the federal government's General Accounting Office published what has been called a "watershed report" on women's health. The report criticized the National Institutes of Health for not including enough women in research studies on various illnesses and their treatments. Many reasons have been given for this failure. Says James S. Todd, executive vice president of the American Medical Association:

> The most obvious reason is simply that men were the doctors and scientists, and so they chose to experiment on other men. The dearth of female researchers also meant that there were few strong voices for women's health issues. Many conditions, such as heart disease, were once thought to be rare in women. And there was a paternalistic tendency to exclude women from clinical trials because of the risks inherent in medical research, particularly for unborn children.

Since 1990, NIH has created an Office of Research on Women's Health and launched the largest ever study on cancer, cardiovascular disease, and osteoporotic fractures in women, the three most common causes of death and disability among women. Researchers are also trying to include equal numbers of men and women in studies of diseases that affect both sexes.

Much remains to be done, however. A more recent GAO report indicates that studies of 53 new drugs failed to examine different reactions to the drugs among men and women. It also indicated that the numbers of women in many studies are still too low.

Creating New Life Forms. DNA is a substance that carries, in a cell, the chemical message we call heredity. The small segments of DNA that instruct cells to function in one way or another are called genes. DNA is a string of genes, all of which command cells in different ways. Genes in DNA regulate certain cells to reproduce and function as skin, others to function as brain cells. DNA instructs cells to assemble amino acids into proteins, which make up important bodily substances including all enzymes, hemoglobin, insulin, and other such hormones. In essence, DNA carries all of the genetic information that makes a human a human or a frog a frog. DNA has the ability to split in half and exactly reproduce itself in the daughter cell. Thus, the genetic code is passed on in generation after generation of cells.



Since the early 1970s, scientists have been able to alter this natural process using a technology called recombinant DNA (recDNA). At its simplest, recDNA is the chemical stitching of a small section of genes from the DNA of one cell into the DNA of a second cell. Once "recombined," the new DNA reproduces itself and the "foreign" section of genes.

The ability to recombine DNA suggested possibilities but also raised concerns. Proponents of recDNA research see it as providing a significant tool for the betterment of the human condition. Using the recDNA technique, for example, scientists synthesized a growth hormone, somatostatin, at approximately one-tenth the previous cost, giving access to this hormone to many more children with growth disorders. These proponents do not believe recDNA research poses undue safety or ethical risks. They see it as a source of new knowledge and new solutions to problems.

Critics of recDNA argue that the potential risks of recDNA are great. They see recDNA as a short-term "technical fix" for problems that are deeply rooted in social and political systems. For example, the world needs only a small amount of food to end hunger; thus, many people are now hungry because we choose, for many reasons, not to distribute the food equitably. RecDNA may allow us to produce more food, but it will not solve the distribution problems.

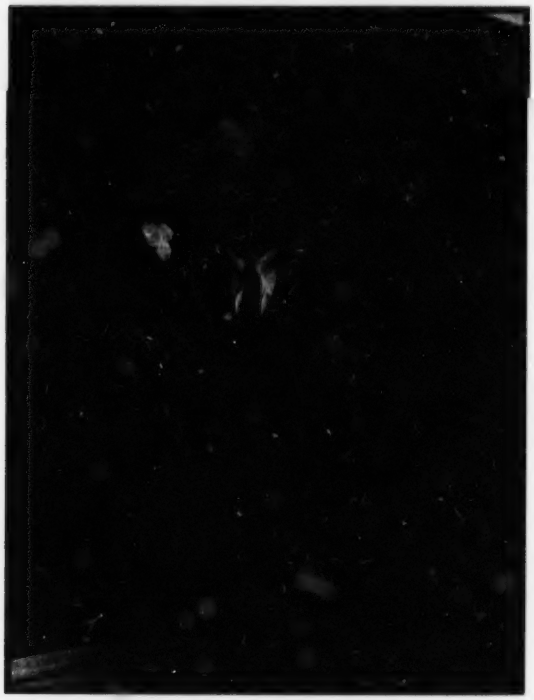
Critics fear possible releases of bacteria that have been recombined and become more virulent. They also argue that manipulating genetic codes could be dangerous in and of itself. Other critics argue that life on earth has been evolving for billions of years and now humans have developed an ability to immediately and consciously overcome significant evolutionary trends and barriers. Should humans be able to tamper with life and evolution itself? Does society have the capacity to handle the consequences of recDNA research?

Many applications of recDNA techniques have been tried; the following are some examples:

- Human genes have been injected into female pigs to cause more eggs to ripen. The eggs are then flushed from the pigs, artificially inseminated in the laboratory, and implanted in the female pigs. The result? More baby pigs.
- Scientists have been working to design cattle vaccines against tropical diseases, with the hope of opening Africa to ranching. Some critics say cattle would replace native African animals.
- The AIDS virus has been crossed with a mouse to allow scientists to test AIDS drugs and vaccines. Some scientists fear that crossing the virus with the mouse may result in changes to the virus to make it more deadly.
- Parents who want their children to grow faster have demanded the human growth hormone, which biotechnology has made widely available.
- Patents have been granted for new forms of animal life. Farmers have protested this action because they do not want to pay royalties and licensing fees when their animals give birth. Animal rights groups fear that scientists will create life forms that will have "miserable" lives.
- In the 1980s, President Reagan revived research on biological weapons. One research project believed to have been conducted by the Department of Defense involved the transfer of deadly genes into bacteria that live naturally in humans.

Which, if any, of these examples would you regard as unethical or dangerous to society in some way? Try to develop a set of guidelines for recDNA research that would prevent these cases but allow those applications you believe to be beneficial to continue.

Oppenheimer: Scientist Accused



The remarkable developments in physics that made nuclear weapons possible also created conflicts for many scientists. In the 1930s, Leo Szilard, one of the first physicists to recognize the possibility of a fission chain reaction, tried to get French, British, and U.S. scientists not to publish the results of their research; he feared that German scientists would use the results of the research to develop an atomic weapon. Other scientists disagreed with Szilard, maintaining that scientists had an obligation to make their work public. In 1940, Szilard finally gained enough support to have the National Academy of Science impose censorship.

The conflict was not over for Szilard, however. In 1945, he and six other scientists protested the expected use of atomic weapons on Japan. Instead, the group suggested a demonstration of the weapon as a

way to convince Japan to surrender. Later that year, Szilard gave up physics and went into biological research.

The conflict between personal beliefs and the role of a scientist also affected J. Robert Oppenheimer, a physicist who led the Manhattan project, which developed the first atomic bomb. In the 1950s, he was charged with being a risk to the security of the United States. As you read Oppenheimer's story, decide how you would have voted on his security clearance.

* * * * *

Oppenheimer's Career

Few modern scientists have ever matched the brilliant career of J. Robert Oppenheimer. He started collecting minerals when he was five years old and became a member of the Mineralogical Club of New York at the age of 11. After attending Harvard for three years, he graduated with the highest honors. He then spent four years in Europe, studying under distinguished scientists and earning his doctorate.

Home in the United States in 1929, he began teaching. Although he read widely, he paid little attention to politics. He later said: "I had no radio, no telephone; I learned of the stock market crash in the fall of 1929 only long after the event; the first time I ever voted was in the presidential election of 1936....I was interested in man and his experience; I was deeply interested in my science; but I had no understanding of the relations of man to his society."

But, beginning in 1936, Oppenheimer started dabbling in politics because of the Nazi persecution of Jews in Germany (where he had relatives) and because of friends and students with political interests. Many of Oppenheimer's associates, including a woman who was his fiancee for a time, had strong left-wing ties. Soon he was contributing money to a variety of political groups, including some run by Communists. In this he was joined by other prominent American educators and artists who sympathized with the Soviet Union during the 1930s.

Oppenheimer ended his flirtation with Communist-backed causes by the early 1940s. In 1942, he began studying the possibilities of developing an atomic bomb for the U.S. war effort. The following year he became head of the Manhattan Project in Los Alamos, New Mexico, where

he assembled and led a group of some 4000 scientists, technicians, and experts.

The achievements of Oppenheimer at Los Alamos place him among the most notable scientist-administrators of all time. He persuaded many of the country's top scientists to live in remote isolation in the West. His tact and insight enabled him to keep this group of individualists working together as a team. The successful test of the atomic bomb on July 16, 1945, was considered a tremendous achievement.

From the beginning, however, there were concerns about how Oppenheimer's past affiliation with left-wing groups would affect his loyalty to the United States. The chief military officer at Los Alamos, General Leslie Richard Groves, believed strongly in Oppenheimer's loyalty, and in fact recommended him for his post.

Still, as part of the tight security measures at Los Alamos, Oppenheimer's movements were carefully watched. A "bodyguard" from the security force watched his activities around the clock. When he visited his former fiancee in San Francisco, the security forces knew it. They also monitored his telephone calls and read his mail.

Many of the scientists who worked at Los Alamos found the security measures restrictive, since they saw free thought and exchange of ideas as both natural and necessary to their work. Although Oppenheimer sympathized with the scientists, he urged them to comply with the security requirements.

Yet early in Oppenheimer's efforts to put the Los Alamos team together—in January or February of 1943—he made a famous false step that would hurt him in the future. In the kitchen of the Oppenheimers' Berkeley, California, home, a visiting friend named Haakon Chevalier told Oppenheimer that another person had approached him about passing scientific data to an agent of the Soviet Union. Oppenheimer dismissed the idea out of hand. He failed, however, to report the incident immediately, as security regulations required. Only several months later did he report the incident, and then he tried to protect Chevalier by inventing a false story. Security officers finally obtained Chevalier's name from him.

Although Oppenheimer resigned from Los Alamos three months after the bombing of Hiroshima, he continued to serve the government in a number of capacities. From 1947 to 1952, Oppenheimer was chair-

man of the General Advisory Committee to the Atomic Energy Commission (AEC).

Meanwhile, the explosion of the first Soviet atomic bomb in 1949—earlier than most U.S. experts expected—set off a new controversy. Edward Teller, one of the nation's leading physicists, had long been working on calculations for an even bigger bomb, nicknamed the "super." Teller now argued that the United States should go ahead with a project to produce this thermonuclear weapon—not only to preserve a military edge over the Soviet Union but also to have equality when the Communists might produce a superbomb of their own.

Teller was shocked when the AEC General Advisory Committee under Oppenheimer unanimously decided against any expansion of work on thermonuclear weapons. Their reasons were technical, military, and moral. In light of the knowledge then available, they doubted that a superbomb could be successfully designed. Two committee members—Enrico Fermi and I.I. Rab—felt overwhelming horror at the destructive power that would lie in such a weapon. Finally, a majority argued that the Soviet Union was only trying to catch up with the United States, that the Soviet Union would not try to develop new weapons unless the United States did. Oppenheimer, as the world's foremost nuclear scientist, led the opposition.

President Harry S. Truman finally decided in favor of developing what would become the hydrogen bomb. The project encountered difficulties, however, and a year and a half passed before Teller made a major breakthrough. At about this time Oppenheimer contributed an idea that proved extremely useful to Teller.

The explosion of the American H-bomb in 1952 officially closed the controversy about whether it would be possible to build such a weapon. And the explosion of a Soviet H-bomb less than a year later seemed to refute the main arguments of American scientists who had urged this nation to shun the weapon.

Questions for Conversation

1. What aspects of Oppenheimer's behavior do you think suggested that he might be a security risk?

2. What reasons did the GAC give for its opposition to the H-bomb? Given the events of the early 1950s, could a case still be made for opposing the bomb?

The Charges Against Oppenheimer

Early in 1954 a former executive director of the Joint Congressional Committee on Atomic Energy sent FBI Director J. Edgar Hoover a letter charging Oppenheimer with opposing development of the H-bomb because he was a Soviet agent. This charge, which was not substantiated, led to a government hearing on whether Oppenheimer should continue to have security clearance to work on secret government projects.

A special Personnel Security Board conducted the Oppenheimer hearing. The hearing took place in Chicago from April 12 to May 6, 1954. A variety of charges were lodged against Oppenheimer and examined during this hearing. These included claims that Oppenheimer:

- Contributed regularly to Communist causes in 1940-42.
- Had been intimately associated with Communists and former Communists, including his former sweetheart, wife, brother, and sister-in-law.
- Gave contradictory evidence to the FBI about attending Communist meetings in the early 1940s.
- Recruited Communists and former Communists to work at Los Alamos during World War II.
- Failed to report promptly the attempt by Haakon Chevalier to obtain secret information for the Soviet Union.
- Strongly opposed the development of the H-bomb and continued to oppose this development even after President Truman's go-ahead.

Several of these charges had special bite at the time they were made, because Senator Joseph McCarthy of Wisconsin still exerted massive influence in national politics. His charges that hundreds of Communists had infiltrated the State Department, Central Intelligence Agency, and other offices of the federal government were widely believed—though never proved. Some government officials were ousted on the grounds of behavior that might indicate sympathy with communism. Dozens of other people were denounced before the national and local press, often on slender or questionable evidence. Some state employees and others lost jobs for refusal to sign loyalty oaths. McCarthy's power was curbed late in 1954 when the Senate censured him, but he still had great influence during the Oppenheimer security hearings.

During the three and a half weeks of testimony, the counsel for the Security Board hammered away at Oppenheimer's failure to be candid about security at several points in his career.

The Haakon Chevalier case was the key incident in charges that Oppenheimer had associated with known Communists in a way harmful to security. Roger Robb, counsel for the Personnel Security Board, queried Oppenheimer about this in the following exchange:

Robb:...Would you begin at the beginning and tell us exactly what happened?

Oppenheimer: Yes. One day, and I believe you have the time fixed better than I do, in the winter of 1942-43, Haakon Chevalier came to our home. It was, I believe, for dinner, but possibly for a drink. When I went out into the pantry, Chevalier followed me or came with me to help me. He said, "I saw George Eltenton recently." Maybe he asked me if I remembered him. That Eltenton had told him that he had a method, he had a means of getting technical information to Soviet scientists. He didn't describe the means. I thought I said, "But this is treason," but I am not sure. I said anyway something, "This is a terrible thing to do." Chevalier said or expressed complete agreement. That was the end of it. It was a very brief conversation.

Robb: In other words, you thought that the course of conduct suggested to Eltenton was an attempt at espionage, didn't you?

Oppenheimer: Sure....

Robb: Now let us go back to your interview with Colonel Pash [security officer]. Did you tell Pash the truth about this thing?

Oppenheimer: No.

Robb: You lied to him?

Oppenheimer: Yes.

Robb: What did you tell Pash that was not true?

Oppenheimer: That Eltenton had attempted to approach members of the project—three members of the project—through intermediaries.

Robb: What else did you tell him that wasn't true?

Oppenheimer: That is all that I remember.

Robb: That is all? Did you tell Pash that Eltenton had attempted to approach three members of the project?

Oppenheimer: Through intermediaries.

Robb: Intermediaries?

Oppenheimer: Through an intermediary.

Robb: So that we may be clear, did you discuss with or disclose to Pash the identity of Chevalier?

Oppenheimer: No.

Robb: Let us refer, then, for the time being, to Chevalier as X.

Oppenheimer: All right.

Robb: Did you tell Pash that X had approached three persons on the project?

Oppenheimer: I am not clear whether I said there were three X's or that X approached three people.

Robb: Didn't you say that X had approached three people?

Oppenheimer: Probably.

Robb: Why did you do that, Doctor?

Oppenheimer: Because I was an idiot.

Robb: Is that your only explanation, Doctor?

Oppenheimer: I was reluctant to mention Chevalier.

The questioning continued, and Oppenheimer repeatedly had to confess his folly.

Questions for Conversation:

1. How do you think the influence of Senator McCarthy might have affected the way in which the Haakon Chevalier incident was interpreted? Do you think Oppenheimer could get a fair hearing in an atmosphere of intense concern and paranoia about Communism in the United States? Why or why not?

2. Oppenheimer and Chevalier were good friends. In your opinion, did Oppenheimer's loyalty to his friend justify his actions? How would you respond if you were asked to identify a friend who had broken the law? Explain your answer.

Oppenheimer's Opposition to the H-Bomb

Another dramatic point in the proceedings came when the prominent physicist Edward Teller was called to testify about his colleague, friend, and scientific adversary. Teller was born in Hungary, but came to the United States as a refugee in the 1930s. Determined to do everything in his power to help his adopted country, he had given years of his life to the cause of U.S. defense. Now he had to evaluate a scientist who had worked on similar problems.

Asked by the Board whether Oppenheimer was disloyal to the United States, Teller replied: "I do not want to suggest anything of the kind. I know Oppenheimer as an intellectually most alert and very complicated person, and I think it would be presumptuous and wrong on my part if I would try in any way to analyze his motives. But I have always assumed, and I now assume, that he is loyal to the United States."

After giving Oppenheimer lavish praise for leading the work on the atomic bomb, Teller described how the situation changed when it came to developing the hydrogen bomb: "It is my belief that if at the end of the war some people like Dr. Oppenheimer would have lent moral support, not even their own work—just moral support—to work on the thermonuclear gadget, we could have kept at least as many people in Los Alamos as we then recruited in 1949 under very difficult conditions.

"I therefore believe that if we had gone to work in 1945, we could have achieved the thermonuclear bomb just about four years earlier...."

Critics felt that Oppenheimer placed his own ideas of morality above those of national security. And there is some evidence that of the three arguments he used against the hydrogen bomb—military, technical, and

moral—the last may have been the overriding one. The newspaper columnist Joseph Alsop, who defended Oppenheimer after the security hearings, quotes him as saying later about the H-bomb: "I guess I concluded it wouldn't work because I wanted it so much not to work."

Critics suggest that if Oppenheimer's attitude had prevailed, the United States might have suddenly found itself in a disastrous military situation. Soviet dictator Joseph Stalin, for example, could have used a monopoly on the H-bomb as international blackmail against the Western democracies.

Even so, Oppenheimer's opposition was not clear-cut. At several stages he gave Teller valuable suggestions on how to proceed with work on the bomb. Furthermore, Oppenheimer was only one of many leading scientists who agreed that the H-bomb was unworkable.

The fact that so many scientists had endorsed Oppenheimer's position and strongly sympathized with him during the security hearings later hurt Teller's position in the scientific community. Teller's own uncertain attitude toward Oppenheimer can be seen in his testimony about whether Oppenheimer should be given security clearance:

"I believe, and that is merely a question of belief and there is no expertness, no real information behind it, that Dr. Oppenheimer's character is such that he would not knowingly and willingly do anything that is designed to endanger the safety of this country. To the extent, therefore, that your question is directed toward intent, I would say I do not see any reason to deny clearance."

But Teller added: "If it is a question of wisdom and judgment, as demonstrated by actions since 1945, then I would say one would be wiser not to grant clearance. I must say that I am myself a little bit confused on this issue, particularly as it refers to a person of Oppenheimer's prestige and influence. May I limit myself to these comments?"

His testimony completed, Teller walked over to the leather couch on which Oppenheimer was seated, shook hands, and quietly said, "I'm sorry." Oppenheimer replied incredulously, "After what you've said, I don't understand what you mean."

Several days and many pages of testimony later, the Personnel Security Board voted 2 to 1 that Oppenheimer's security clearance should be revoked. The AEC then voted 4 to 1 to confirm the Board's findings. In conclusion, the AEC stated:

"These episodes separately and together present a serious picture. It is clear that for one who has had access for so long to the most vital defense secrets of the government and who would retain such access if his clearance were continued, Dr. Oppenheimer has defaulted not once but many times upon the obligations that should and must be willingly borne by citizens in the national service.

"Concern for the defense and security of the United States requires that Dr. Oppenheimer's clearance should not be reinstated.

Dr. J. Robert Oppenheimer is hereby denied access to restricted data."

Denial of security clearance not only removed Oppenheimer from association with American military matters, but it also effectively ended his influence in the government. He retired to his position as head of the Institute of Advanced Study in Princeton, badly wounded by the stigma of unreliability. For years afterward he was trailed by government agents when he traveled, his phone was tapped, and his family exposed to public embarrassment.

Before his death in 1967, a kind of reconciliation took place between Oppenheimer and the nation to which he had given so much of himself. In 1962, President John F. Kennedy invited him to a dinner at the White House for Nobel Prize winners. The following year J. Robert Oppenheimer received the AEC's coveted Enrico Fermi Award for his contributions to the development of atomic energy. Among the leading U.S. scientists who had nominated him was Edward Teller.

Questions for Conversation

1. Describe Teller's position during the hearings. If you had been Oppenheimer, what would you have said to Teller when he approached you following his testimony?

2. Can a person be loyal to his/her country and still be a security risk? Give examples to support your answer.

Persisting Questions of History

Patriotism and Scientific Beliefs. Oppenheimer's loyalty was questioned, in part, because he opposed development of the H-bomb. Do you think opposition to the development of a particular weapon would be regarded as disloyal or unpatriotic at other times? Why or why not?

Choose one of the following examples to research. Find out how opposition to each of these weapons systems was regarded at the time. How were political conditions in the United States similar to or different to conditions in the early 1950s? What aspects of foreign relations affected how opponents of weapons systems were viewed?

a. President Nixon's proposal to develop an anti-ballistic missile system.

b. The proposal to develop the neutron bomb during President Carter's administration.

c. President Reagan's strategic defense initiative (also called "Star Wars").

Personal Action on Moral Commitment. Suppose that a scientist, Dr. Greenley, is working on a *classified* weapons project. He learns that the project is trying to develop a weapon far more powerful than existing weapons. It will have incredible destructive power, and no defense against the weapon can be developed. Greenley decides that on moral grounds he must oppose the project.

Dr. Greenley ponders several personal choices. He could:

a. Continue to work diligently on the project.

b. Stay on the job and openly try to persuade and organize fellow workers to refuse to work on the project.

c. Stay on the job and secretly organize a small ring of workers to sabotage the project by deliberately falsifying data and planning "accidents" that damage equipment, etc.

d. Organize a campaign to make the classified project known to the public—seeking help from newspapers, TV, and citizens' groups to exert pressure on the government to stop the project.

e. Resign his job and return to private life without raising the question publicly.

Add any other choices you think would be available to Dr. Greenley. Which course of action would be most patriotic? Which would be most in line with Dr. Greenley's beliefs as a scientist? Which seems most justified morally? Why?

Objective Knowledge, Policy Advice, and Moral Responsibility. To what extent do you agree with the following position: "As a scientist my primary responsibility is to increase scientific knowledge. I do not have the right to censor or hide my findings or to refuse to pursue a line of experimentation simply because I see a possibility that my knowledge might be used to hurt mankind. *How* discoveries should be used must be decided by the citizen, not the scientist. Thus, scientists whose scholarship is used to develop horrendous weapons bear no moral responsibility for the damage done. That responsibility rests solely with the people who have decided that the weapons should be built and used."

If we accept this position, what should we conclude about the propriety of Oppenheimer's advising against, and Teller's advising for, the development of the H-bomb? Should either of them have taken a stand on whether the weapon should be developed? Does the fact that each took a stand increase his moral responsibility for the consequences of the policy he recommended?

Suppose the Defense Department seeks advice on whether the United States should develop a gas that when released above a city would instantly destroy the reproductive capacity of all persons (sterilize them) within a 5-mile radius. Here are three possible replies of scientists who have been summoned as consultants. Which response do you think is most appropriate? Why?

Dr. Kowsky: "As a scientist, I cannot and will not tell you whether to develop such a weapon. I will tell you only whether it is possible to develop such a weapon."

Dr. Jones: "I refuse to give you any information on the matter. The act of concentrating so many of our national resources on atrocious weapons is immoral, and I fear that you will use my knowledge to implement unjustified policies."

Dr. Rodriguez: "As a scientist I can and will testify on the scientific possibility of creating the weapon. But since I am inseparably both a

scientist and a citizen, I, therefore, have an obligation to advise you also on whether such a weapon would be desirable to build."

The Objective Search for Truth. In saying "I guess I concluded it wouldn't work because I wanted it so much not to work," Oppenheimer recognized that his personal beliefs affected his professional judgment. Traditionally, the image of the ideal scientist has been of an objective searcher for truth. Is this ideal of value-free, research possible, or are scientists, as human beings, necessarily affected by their own values?

Should Nazi Data Be Used?*

Does the way in which information is generated affect whether or how the information itself should be used? This is the question that arises when scientists consider whether the studies of German researchers conducted in death camps should be used today. Is the data tainted by Nazi crimes or is it morally neutral? Should researchers treat this information any differently than data gathered in ethically acceptable ways? As you read the dilemma and opinions below, develop your own opinion on the issue.

* * * * *

Dr. A's Dilemma

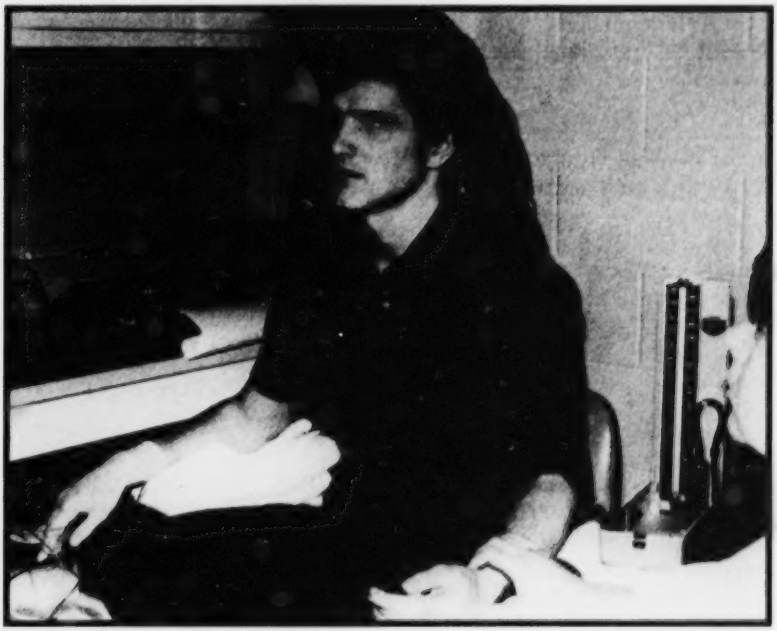
Dr. A is currently studying hypothermia, subnormal body temperature. Most of his data come from experiments with fully informed volunteers whose responses are carefully monitored as their body temperature is lowered in a cold water tank or shiver chamber. Dr. A, of course, also relies on results gathered by previous hypothermia investigators.

Among this material, however, are certain data that trouble him. These are the observations of Nazi researchers at Dachau [a concentration camp]. These researchers casually sacrificed an unknown number of lives in hypothermia experiments.

After careful review, Dr. A believes the Nazi data are reliable. Dr. A considers this data to be particularly important, since he is both unwilling and unable to take his research subjects as far as the Nazis took theirs; at the same time, he is appalled at the prospect that a published report of his work should be linked to crimes against humanity.

Dr. A examines several options. He could simply use the Nazi data; he could reject the data on moral grounds and cite only other research; or he could use the data but cite it only along with a condemnation of Nazi methods. Dr. A is uncertain whether this last option would be a sensitive gesture or merely seem hypocritical.

*Adapted from "Nazi Data: Disassociation from Evil," *Hastings Center Report* 19, no. 4 (July/August 1989), pp. 16-18.



A hypothermia experiment

Opinion 1

As a medical researcher, Dr. A is motivated by a desire to contribute to scientific understanding and to improving and preserving life. If Dr. A believes that use of the Nazi data will contribute to the preservation of human life, he should cite it in his own research. Nevertheless, he realizes that the data are not morally neutral. Nazi medicine lost sight of its duty to preserve life. Dr. A is aware of the barbarity that produced the data and he must wonder if the men, women, and children who were tortured and murdered will be further violated by use and citation of the data. This question is difficult because it is impossible to know what the victims themselves would have wanted done with the data. It is also impossible to discern what effect using the data will have on society, on the collective memory of the Holocaust, or on the future of medical research.

Use of data from Nazi research is justifiable under certain conditions. The data must be reliable, unavailable from any other source, and

capable of contributing to the greater good. Publication of the data must be accompanied by a clear condemnation of the way in which the data were collected.

Dr. A seems to have resolved the first two conditions responsibly. The central issue related to the third condition is the concern that drew Dr. A to his profession—the desire to contribute to human understanding to preserve life. If the data can preserve life, Dr. A not only can, but should use it. Then he must face the challenge of creatively and continuously sustaining a sense of condemnation that keeps alive the memories of the victims and fights against a future that replicates the past.

Opinion 2

Perhaps the most intriguing question is whether scientific data can acquire a moral taint. Common sense seems to indicate that a parcel of information about the physical world is morally neutral. Since our society so highly esteems an understanding of the physical universe, some might even argue that any such information is inherently valuable. Why should this be any different for some apparently reliable data simply because the circumstances under which they were gathered horrify us?

However, regarding the data as morally neutral ignores an important aspect of human discourse. Anything used to communicate—be it words, symbols, or data—achieves much of its meaning through association. A cross is only the transection of two pieces of wood, unless one happens to be a Christian. A swastika is a similar figure, unless one happens to identify with the National Socialists—or their victims.

Is it possible for scientists to ignore historical associations or at least place them in brackets and set them aside? It would be easier to say yes if scientists did not communicate with the public. If a scientist gives inhumanely extorted data a place in his or her work, public confidence is rightly shaken.

Dr. A should reject the Nazi data. This course of action grows out of the belief that contemporary scientific inquiry can and should proceed in a thoughtful, morally reflective atmosphere. Researchers should make their decisions not primarily from a desire to condemn the Nazis or even to commemorate their victims but rather out of concern for themselves as moral beings.

Opinion 3

Despite the oft-repeated statement that in science "anything that can be done, will be done," much that could be done in human research and that would have been beneficial to do, was not done because it was inhumane. We do not separate twins at birth to study the influences of heredity and culture on identical creatures. We do not allow people to "volunteer" for radiation experiments or burning mutilation—even though the data accumulated could be of enormous help in saving lives. We do not replicate the Nazi experiments. On a utilitarian calculus it might be worth it. "We" do not do it. The Nazis did.

The Holocaust is beyond comprehension. The destruction of six million Jews for no other reason than that they were Jews would have been sufficient to mark this as a monstrosity of the first order. The torture and pain, humiliation and degradation visited upon them adds its dimension of surrealistic bewilderment. The indifference of the world at large makes of the event an unfathomable morass.

There is no ambiguity with the present case. We cannot cite data gathered through atrocities. To use this data is to become an onlooker, and beyond that, an accomplice. To publish this data in a scientific journal is to legitimize it. The Nazi medical experiments were but threads in the tapestry of evil that was the Holocaust, but no thread must be dignified by its utility.

Persisting Questions of History

Taking and Defending a Position. Which of the opinions above is closest to your own opinion on whether Dr. A should use the Nazi data? Explain your position, being sure to comment on whether data can, in fact, be morally neutral. If you think Dr. A should not use the data, are there any circumstances in which you think such data should be used?

Analyzing an Analogy. Irmgard Flugge-Lotz and her husband Wilhelm Flugge were German engineers. Although they held anti-Nazi views, they were protected by Hermann Goering, Germany's Luftwaffe commander. Goering wished to take advantage of their engineering skills, especially Irmgard's pioneering work in aircraft navigation.

Given their anti-Nazi views, do you think the Flugges should have made their work available to the German government? What options, if any, did they have? Which obligation do you think was primary—their responsibility to science, to themselves, to their country, or to humankind? How do you think their decision is similar to that faced by Dr. A? How is it different? Can you see any similarities between this case and that of Dr. Oppenheimer?

A Fight Over Fluoridation*

What is the citizen's role in making decisions about highly technical matters? How is that role complicated by disagreements among the so-called "experts"? These are questions that had to be faced when a clash between two doctors, both of whom wanted what was best for their town, disrupted the community. As you read the case, think about how you would have reacted as a citizen of Mountaintop.

* * * * *

Dr. Cordwain's Campaign

James Cordwain, D.D.S., glanced over his neat office as he prepared to leave. Through the window he could see a huge lonely elm and the last of the day's sunlight flooding the brick sidewalk. Mountaintop was a good place to live—small but friendly.

Dr. Cordwain checked the envelope inside his coat pocket. His nurse, Gladys, had once again typed the report he was to give to the town meeting that night. She must have typed it half a dozen times as he revised his presentation of a plan to bring up a generation of kids without the endless tooth problems that plagued their parents.

Almost 40, Dr. Cordwain felt vaguely discontented with the idea of doing nothing more with his life than repairing teeth. He was, in a sense, looking for a cause; curbing tooth decay among children looked like an excellent chance to help the entire community.

That evening, James Cordwain, dressed in casual clothes, told the 290 people assembled for the town meeting about the American Dental Association's endorsement of fluoridated drinking water as a means of decreasing tooth decay. With one part fluoride to a million parts water, tooth decay among children ultimately decreased by 60 percent. Studies showed that teeth would not mottle or stain even with a higher percentage of fluoride. Nor was there any significant study showing that older people were harmed by such water.

The proposal to fluoridate Mountaintop's water passed without a hitch. No one disagreed with the ADA's endorsement or challenged the

*This story is fictional, but it authentically represents an actual controversy over fluoridation in a New England town in the 1950s.

impressive research that supported fluoridation. The actual vote was 279 for, 9 against, and 2 abstaining. One of the abstainers was Dr. Peter Novak, the town's leading doctor.

Afterwards, Cordwain couldn't resist needling him: "How come you aren't moving with the times, Doc?" But Novak didn't smile. Hesitating a moment, he said: "I'm going to have to know a little more about the long-range effects of fluoridation before I'll back it."

One of those who voted against fluoridation sent a sizzling letter to the *Mountaintop Press* the next day. Cordwain had to chuckle at the wild charges it contained:

To the Editor:

The people of Mountaintop have been sold a bill of goods. How many of you really want to be guinea pigs for medicine that is still an unknown quantity, that could poison us with every mouthful of water that we drink? Sure we want our kids to grow up with good teeth, but some of us old-timers want to live a few more years, too. It is well-known that big aluminum companies plan to fluoridate this country so that they can cash in. Well I say let them peddle their rat poison in some other town.

John Thompson
Oak Street

Cordwain read the letter to his wife and laughed: "You might know Jack Thompson would come out against fluoridation. Why he probably used to be against vitamins and penicillin."

Two days later, another letter appeared in the *Press*. This one was from Dr. Novak. He had been practicing in Mountaintop for almost half of his 57 years. He had a reputation for thoroughness that hardly anyone in town could match. This reputation was bound to give his letter extra weight:

To the Editor:

I can hardly agree with all of John Thompson's letter on fluoridation. For example, I'm not particularly concerned about who makes the fluorides we propose to add to our water. But I do think we should consider the whole matter of fluoridation at greater length.

Many scientists early in this century endorsed the lavish use of X rays, and a lot of people died or became disabled in the process. The adding of fluoride to drinking water is still a new process, one not yet fully explored. I want to see some more evidence before rushing headlong into fluoridation.

However, this letter should not be construed as opposition to the vote we took earlier this week. I just want to go on record as one of those who wonder if Mountaintop isn't being a little hasty.

Peter Novak, M.D.
Atkinson Place

Now Cordwain had to reply. His letter went over some of the ground covered at the town meeting and added a few more facts:

To the Editor:

Dr. Novak's thoughtful letter deserves an answer in the same responsible vein. Pete and I may occasionally disagree, but I think each of us recognizes that the other is responsible and scientific.

Many studies since World War II have shown that fluoridated drinking water helps prevent tooth decay in children and has absolutely no harmful side effects. For example, a study begun in Newburgh, New York, in 1945 showed that the children there drinking fluoridated water from birth had 58 percent less tooth decay compared with children in a control group. Studies in Grand Rapids, Michigan, and Brantford, Ontario, yielded similar results.

Studies of adults who have been drinking water with a naturally high fluoride content for many years show no harmful side effects. These adults are just as healthy as other adults their age in every way that can be measured.

Dr. Nicholas C. Leone, Chief of Medical Investigation for the National Institute of Dental Research, says: "We know without question or doubt, that one part per million fluoride in a water supply is absolutely safe, is beneficial, and is not productive of any undesirable systemic effect in humans."

What more can I say? The best scientific research available shows that Mountaintop has made a wise decision.

James Cordwain, D.D.S
Dewey Street

But seeds of doubt had been sown throughout the town. Some people began to wonder whether the apparent benefits of fluoridation really offset the possibility, however remote, that they would slowly poison themselves. One result was that the Board of Selectmen started dragging its feet in buying fluoridation equipment. Some of the selectmen obviously wanted to be sure of just what the prevailing sentiment was among the silent majority of the townspeople.

Tension over the question increased when several hundred townspeople received an anonymous flyer with the heading: "Red Plot to Cripple America." This crudely written pamphlet claimed that Communists were behind the drive for fluoridation, because fluorides would undermine the health of the nation. At the end was a plea for all patriotic Americans to unite against the danger.

Cordwain shrugged off the pamphlet. He believed that the people of Mountaintop were sensible enough to recognize a smear campaign of this sort. What seemed to him more serious was the organization of an Antifluoridation Committee under the leadership of Peter Novak. Apparently Novak's doubts about fluoridation had crystallized.

Questions for Conversation

1. According to the evidence Dr. Cordwain presented, what are the results of long-term fluoridation of drinking water? How did he support his arguments?

2. What do you think were the strongest arguments against fluoridation presented by John Thompson and Dr. Novak?

The Opposition Takes Action

The committee soon sponsored a public talk on fluoridation by a dental surgeon associated with the major hospital in a nearby community. The talk was held in Mountaintop's largest auditorium, and the entire town was invited to hear the "Facts About Fluoridation."

The surgeon, a dramatic speaker, told the jam-packed auditorium that fluoridation could well amount to suicide. He displayed a murky-looking bottle labeled "Fluoride—Caution." He presented a statement, said to have been signed by more than 100 dentists, opposing fluoridation.

Most of the surgeon's talk dealt with scientific doubts about the value of fluoridation. Even if death or illness rates showed no dramatic rise, he said, people with unusual medical problems might well die because of added fluorides. "Who are we," he asked the audience, "to play God with our neighbor and jeopardize his life, just to reduce cavities?" Again, the surgeon noted that leading dental authorities had agreed that tooth decay had complex causes. Fluoridation might suppress a few of these causes, yet other preventive measures, such as better tooth brushing habits, might well be more effective.

He quoted a Dr. Raymond L. Girardot, who told the Detroit District Dental Society: "Dental caries is a symptom of imbalanced blood chemistry, which in turn is the result of certain deficiencies and the intake of toxic substances. To attempt to reduce the index of the symptom and do nothing toward the removal of the cause is scientific nonsense."

As a clincher, the surgeon said that although it was hard to prove, big business apparently was trying to foster a fluoridation craze. He cited an article that appeared in *Chemical Week* a few years before: "Only 1 percent of the nation's water is now treated; thus the market potential has fluoride chemical makers goggle-eyed....Most of these firms are now aiming sales campaigns at municipal water authorities."

Dr. Novak, who was serving as moderator, thanked the surgeon for his presentation. He said that although he personally might not agree with everything in the talk, he felt that facts had been presented that everyone in Mountaintop should think about. He then called for questions from the audience.

James Cordwain jumped to his feet, hand waving. Dr. Novak smiled grimly and said, "Okay, Jim, now it's your turn."

Facing the packed auditorium, Cordwain began: "I won't take the time to point out every fallacy in the talk we have just heard, but it must be obvious to everyone here that the speaker relies chiefly on innuendo. Disregarding more than a dozen studies of communities actually using fluoridated water over a period of years, he warns that maybe one or two people may have been hurt by it. He brings up the irrelevant point that cavities may also be curbed in other ways. He...."

Then the interruptions began. A man hollered; "We aren't your guinea pigs." A woman shouted: "Let's keep Mountaintop American." A muttered chorus backed the hecklers. Dr. Novak frantically tried to keep the audience quiet.

Cordwain resumed his discussion, citing the research done in communities across the nation, dismissing the talk of plots as totally unfounded, and pleading for the audience to consider the problem rationally. But he realized that his words were having little effect. People's minds seemed to be made up, and quite a few felt personally threatened by the prospect of drinking water that was one-millionth fluoride.

Later, as James Cordwain thought over the events at the meeting, he was consoled by the hope that once the scheduled fluoridation of the water began, opponents would calm down. They would see that there was nothing appreciably different about the water, and thrift would work against shunting aside equipment already paid for.

But "F-Day," as the critics dubbed the first day of fluoridated water, was marked by complaints pouring in to doctors, the hospital, and the town selectmen. A number of people had stomachaches they blamed on the water. Others reported discolored sinks or laundry. One woman claimed her goldfish had been "fluoridated to death."

James Cordwain joined with 11 supporters in running a full-page ad the following night in the *Mountaintop Press*. It was headed: "The Best Water in Our History," and it told readers that the minute trace of fluoride now in Mountaintop water couldn't possibly give anybody a stomachache. The only difference the water would make would be in the improved teeth of young children—after several years of use.

This explanation had no visible effect on the critics, whose mood varied from panic to outrage. Despite the efforts of Dr. Novak to keep

the opposition on a rational basis, many townspeople wanted drastic action to clear their drinking water of fluoride. This urgency accounted for the speed with which opponents got 500 signatures on a petition to call an emergency town meeting to consider defluoridation.

Two weeks after F-Day, the town meeting took place. A record 1,600 people came—more than five times the number of those who had voted approval. Amid the tumult, James Cordwain pushed his way to the front of the auditorium to make a last plea to preserve fluoridation. Then speaker after speaker got up to blast fluoridation.

One of the calmest speakers was Dr. Novak. He urged: "Like a lot of you, I'm here to get fluoridation repealed. But let's do it for the right reasons. Fluorides are not communistic or anti-American. They are, in my opinion, being offered to us prematurely. In 10 or 15 years, after many more tests have been run, I may be up here begging for fluoridation. But let's not have it now."

The vote, when finally taken, handed a resounding defeat to James Cordwain and the other fluoridationists. By 1,268 to 321, the town of Mountaintop decided that it wanted water free of fluorides.

Questions for Conversation

1. Why did the surgeon say fluoridation was harmful? Do you find his arguments convincing? Why or why not? Do you think most of the residents of Mountaintop agree with you?

2. Why do you think the majority at the last town meeting vote as they did? Would you have voted with them? Why or why not?

Persisting Questions of History

Deciding Who Should Decide. Consider the following positions in dealing with the question of who should make public policy decisions that require use of scientific data:

Brittany: The citizens of Mountaintop had no business making a decision on fluoridation by majority vote in a town meeting. This was a scientific question that should have been made by medical people and scientists. The average citizen is simply incompetent to evaluate conflicting scientific information. If you want to take a safe airplane trip, you make sure a skilled pilot is flying. Decisions like this should be left up to qualified experts.

Julio: Leaving it up to the scientists won't solve the problem, because, as we saw in the story, even medical doctors will disagree on medical-scientific questions. Doctors disagree on treatments, including the use of various drugs. In trials, psychiatrists disagree as to whether an accused person is mentally ill. Leaving the decision to experts doesn't solve many controversies.

Which of the following questions should be put to a vote of the citizens of Mountaintop? Why? If you believe the question should not be decided by majority vote, tell how it should be decided and why.

a. Should Mountaintop have fluoridated water?

b. How much fluoride per gallon should be put in Mountaintop's water?

c. What restrictions, if any, should be placed on industries in Mountaintop to prevent air and water pollution?

d. What are the major causes of air and water pollution in Mountaintop?

e. Should a company be allowed to build a condominium complex on previously undeveloped land just within the town boundary?

f. How should the condominium complex be designed (i.e., what building materials should be used, how many units should be built, how much open space should be maintained around the units)?

g. Should smoking be banned in all public buildings in Mountaintop?

h. Should smoking be banned in outdoor facilities (e.g., football stadium, parks) in Mountaintop?

i. Should unvaccinated children be allowed to enroll in Mountaintop's schools?

What are the differences between issues that you would leave to citizens and issues you think experts should decide?

The Government, Universities, and Scientific Research. During the 1960s, scientists at more than 50 U.S. universities were conducting government-funded research on chemical and bacteriological weapons (CBW). Among the weapons being researched were those that attack plants, animals, and humans. Some of the types of weapons being studied were microorganisms such as bacteria; chemical poisons; carriers of disease, such as insects; pests of farm animals and plants; and chemical anticrop compounds.

Students and faculty at many of the universities participating in this research became concerned about CBW. They believed that more Americans should be aware of the U.S. expenditures in this field. Many wanted their own universities to stop participating in such research. They organized protests to develop public awareness and to put pressure on university officials to stop accepting research funds for work related to CBW.

Do you think that the faculty and students of a university should be able to determine what kind of research is conducted at the university? Consider the statements below in developing your position:

Yolanda: This university has no business conducting any kind of secret research that isn't going to be published, and especially research that is a crime against humanity. As citizens, we have not been allowed to vote on whether the U.S. government should spend money on CBW research. The individual conscience of every faculty member, university employee, and student should demand that we take action to stop this research by rescinding the university's cooperation in it.

Bryant: We need weapons to keep our country safe. Riots, crime, drug lords from other countries, irrational foreign leaders—all could threaten national security. Every university that accepts federal money—and we would be a second-rate college without federal help—has an obligation to make some contribution to the defense of the nation, either through weapons research or military training. If we don't believe that

CBW research is appropriate, we should express our opinions to our elected officials, not through protests at universities that are just doing what they are supposed to do.

Barbara: No one should dictate the kinds of research a scientist can pursue. This would be an unwarranted infringement on a person's freedom to inquire. Instead, it should be up to the individual researcher to decide what subjects to explore and whether to make the findings available to the general public. The individual's conscience will tell him or her what is moral and in the public interest. We must have a free marketplace of ideas.

Conflicting Views on Climate Change. Is the earth's climate changing? If so, how will the changes affect life on the planet? Those are among today's issues on which scientists disagree.

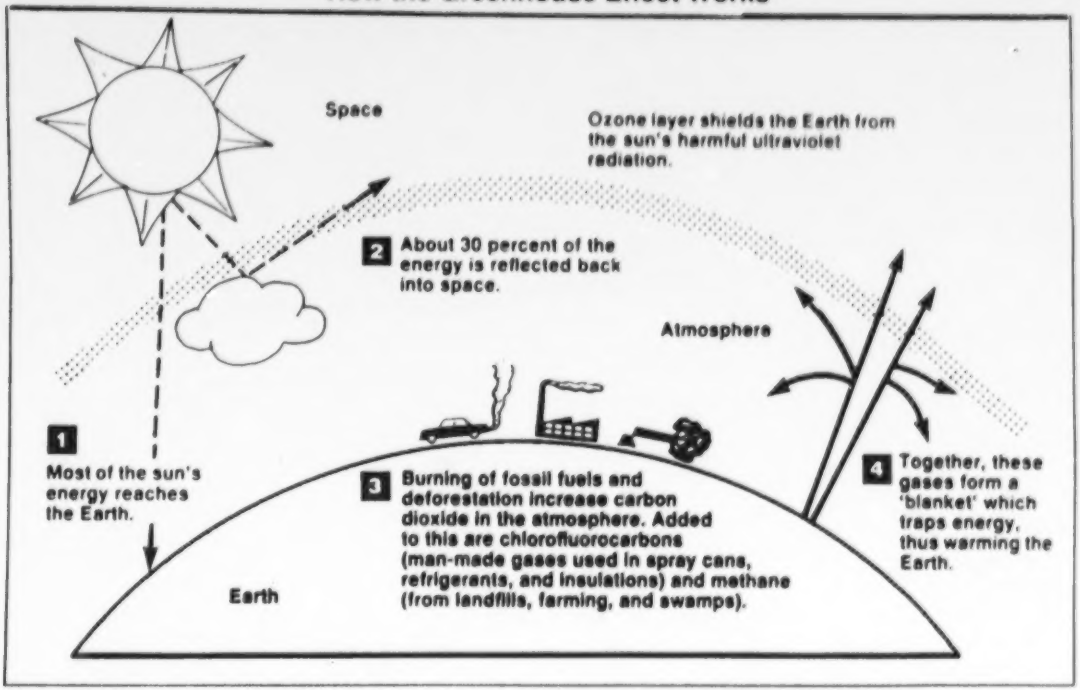
The argument that the earth's climate is changing is based on what is known as the greenhouse effect (see diagram). The earth's surface is warm because of a natural greenhouse effect, in which gases from the atmosphere absorb infrared radiation that would otherwise escape into space. These gases include carbon dioxide, methane, and chlorofluorocarbons. Activities that increase the concentrations of these gases are creating a much greater greenhouse effect. Such activities include burning fossil fuel, deforestation, use of chlorofluorocarbons in refrigerants and insulation, and production of methane from landfills and certain farming techniques. The United States is the largest producer of "greenhouse gases."

Evidence that the climate might be changing can be seen in weather records. The 1980s was the warmest decade since weather records have been kept; 1990 was the hottest year on record. But scientists can't say for sure that these warm years show a trend. They may simply be a natural fluctuation. In fact, changes to date have not been as great as scientists predicted using computer models.

Many scientists do believe that change is occurring. A study by the Intergovernmental Panel on Climate Change concluded that, without changes in the activities that create "greenhouse gases," the average temperature around the world will increase about 3°C in the 21st century.

How much would such an increase in temperature affect life on earth? Some scientists say that the impact could be significant, reducing large areas of the world to deserts.

How the Greenhouse Effect Works


Space
Ozone layer shields the Earth from the sun's harmful ultraviolet radiation.
2 About 30 percent of the energy is reflected back into space.
Atmosphere
1 Most of the sun's energy reaches the Earth.
3 Burning of fossil fuels and deforestation increase carbon dioxide in the atmosphere. Added to this are chlorofluorocarbons (man-made gases used in spray cans, refrigerants, and insulations) and methane (from landfills, farming, and swamps).
4 Together, these gases form a 'blanket' which traps energy, thus warming the Earth.
Earth

Source: World Resources Institute, *Changing Climate: A Guide to the Greenhouse Effect* (World Resources Institute, Washington, D.C., 1989).

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Other scientists disagree. One such scientist, Patrick Michaels of the University of Virginia, argues that warming will not be as drastic as predicted. Furthermore, Michaels believes that the impact may be positive, allowing a longer growing season in Canada, Northern Europe, and northern Asia. Michaels says that most government-sponsored research overexaggerates the problem because that is what governments want—an opportunity to tax and regulate.

Those who believe global warming is a problem that should be addressed disagree. They claim that Michaels' research cannot be trusted because it is funded by industry, which wants to avoid costly changes in the way it does business in order to protect short-term profits.

Gordon Bonan of the National Center for Atmospheric Research agrees that much is unknown about the effects of global climate change. He says, however, "We know we are radically changing the chemistry of the environment. Do we hope, in the future, that we find some way [to readjust the environment] or do we rectify what we think is the problem now?"

Whom do you believe? Do you think government-sponsored research is more or less biased than industry-sponsored research? Why?

Do you think we should act on a problem whose effects are not yet completely understood? Which, if any, of the following actions would you support taking, given the current understanding of global warming and its effects:

- Requiring home owners to improve insulation of their hot water heaters, reducing carbon emissions.
- Requiring manufacturers to create more efficient (and more expensive) refrigerators and freezers.
- Taxing people who do not carpool or take public transportation to work or school.
- Requiring that car manufacturers achieve at least 40 miles per gallon fuel efficiency.
- Outlawing the use of power lawn mowers.
- Signing an international treaty that would limit deforestation in developing countries.

- Signing an international treaty that would require the United States and other industrialized countries to provide aid to developing nations affected by the ban on deforestation.
- Signing an international treaty that would limit the industrial use of coal.

Who do you think should make decisions about such issues—citizens, public officials, scientists? Should decisions be made at the local, national, or international level? Why?

Doctors, Patients, and Decisions About Treatment*

Questions about the roles of "experts" and "nonexperts" in making decisions that involve technical information become particularly thorny when those decisions concern provision of medical care to patients believed to be terminally ill. In the past 20 years, Americans have demanded greater voice in decisions about their own and family members' medical care. This greater participation in decision making is embodied in the doctrine of informed consent, which says that patients have the right to be fully informed of the benefits and risks of treatment proposed by doctors and must consent to such treatment before it is administered.

Some states have actually enacted laws that require patients to answer written questions about the extent of treatment they want under particular conditions; these questions must be answered before the patient is admitted to the hospital. Of course, patients who are unconscious cannot complete these questions, leaving their wishes unknown.

A majority of physicians claim to support the patient's right to make such decisions. For example, a Harris poll showed that 90 percent of doctors believed a decision about treatment should be made either jointly by the doctor and the patient or by the patient alone.

Reality is more complex, however. According to a study conducted by sociologist Robert Zussman in two hospitals, physicians are usually sympathetic when patients or families want to limit treatment in cases of incurable illness. When a patient or family wants everything done, physicians often resist this decision, looking for ways to limit treatment despite the wishes of patients and families.

As you read the cases below, which were taken from Zussman's study, think about the way in which doctors made decisions in these cases. Do you think they acted ethically? Why or why not? Do you think the patients and their families should have handled medical information differently? If so, how?

*Adapted from *Intensive Care: Medical Ethics and the Medical Profession*, by Robert Zussman (Chicago: University of Chicago Press, 1992).

The Case of Scranton Haskell

Mr. Haskell, a 73-year-old former construction worker, was admitted to Outerboro Hospital for gastrointestinal bleeding and a possible heart attack. At the time of his admission, Mr. Haskell had been undergoing evaluation for a mass in his lung. On the seventh day of Mr. Haskell's hospitalization, a lab report confirmed that he had cancer.

The following day, Mr. Haskell was transferred to the ICU. That day, one of the ICU doctors, Sam, asked whether Mr. Haskell and his family were aware that the diagnosis of cancer had been confirmed. Told that they were not, he suggested reservations about an unlimited course of treatment: "I think we have to sit down with the wife and discuss what we know and what we suspect, holding nothing back." However, as an intern explained the following morning, Mr. Haskell himself "doesn't want his wife to know how sick he is." The discussion with the wife was postponed. On the eleventh day of his hospitalization, Mr. Haskell was placed on a respirator.

On the twenty-second day of Mr. Haskell's hospital stay, his bleeding had slowed and the ICU staff was attempting, slowly, to wean him from the respirator. Because he was sedated and had a tube in his throat, Mr. Haskell's mental status was difficult to assess. He did, however, continue to respond to commands by blinking his eyes and squeezing hands. There was no treatment available for his underlying cancer.

The following day, with Mr. Haskell's mental status declining, a resident reported that he had spoken to Mrs. Haskell. At the same time, the resident began to prepare for a decision to withhold treatment, independent of her wishes, by questioning her judgment: "I talked to the wife yesterday. She has very poor insight. Basically, she wants him kept alive." He also reported that she had liquor on her breath.

Sam acknowledged Mrs. Haskell's wishes but subtly shifted the grounds for respecting them from a respect for rights to psychological and humane concerns: "We really should not try to browbeat this lady. She's going through hell." Moreover, Sam immediately qualified his acceptance of Mrs. Haskell's wishes:

> But we should view dramatic interventions [cautiously]....If there's a cardiac arrest, we should institute therapy but we don't have to sustain it and we can send him to the East Wing [a unit with less intensive nursing and medical care].

Sam's comments turned a neat trick. On the one hand, they expressed sympathy for Mrs. Haskell. On the other hand, they removed two issues—how actively to respond in the event of an arrest and where in the hospital Mr. Haskell should be treated—from the realm of Mrs. Haskell's rights. Thus, Sam managed both to respect and resist Mrs. Haskell's right to decide.

On the twenty-ninth day of his hospital stay, Mr. Haskell had begun to bleed again. Mrs. Haskell continued to press for aggressive treatment. After rounds, an intern noted in Mr. Haskell's chart that no further blood transfusions would be given because of the grim prognosis. This was the first explicit order in Mr. Haskell's chart to withhold a potentially life-sustaining treatment. On the thirty-first day, the ICU staff successfully weaned Mr. Haskell from the respirator. On rounds, one of the residents asked whether Mr. Haskell should have a new tube inserted if his breathing worsened. One of the doctors, Mark, answered that they should not: "I'd put it, 'It's futile.' That means it's not a family decision. So we shouldn't ask the family if they want him back on the respirator if he worsens. We can just say it won't do anything."

That afternoon, Mr. Haskell was transferred to a bed on the wards. Later that day, apparently convinced by the transfer, Mrs. Haskell agreed to make her husband DNR (do not resuscitate). A note in Mr. Haskell's chart read simply: "Given critical nature of patient's disease, and clearly poor prognosis, decision for supportive care only made by family." Mr. Haskell died three days later.

Questions for Conversation

1. Who actually made the decision regarding treatment of Mr. Haskell? What was the role of Mrs. Haskell? of the doctors? Do you think the decision was made in an ethically acceptable manner? Why or why not?

2. What arguments could be made for not honoring Mrs. Haskell's wishes regarding her husband's treatment? In your opinion, which of these arguments is the strongest? Why?

The Case of Kelly Connors

Kelly Connors was a 20-year-old preschool teacher. She had been admitted to the Countryside Hospital Intensive Care Unit from the emergency room of a nearby hospital, where her parents and fiance had taken her for what they described as "flu-like" symptoms. But the physi-

cians in the emergency room quickly realized that Kelly was suffering from something far more serious than the flu. They immediately transferred her to Countryside for treatment of acute renal failure complicated by bilateral pneumonia, hypoxia, and hemoptysis. The ICU physicians began her on emergency dialysis for her renal failure and treated her acute respiratory distress with a special, rarely used jet ventilator.

Kelly made it through the night, and the next morning the unit physicians and nurses were congratulating themselves on a remarkable "save." For nearly four weeks, with her father, mother, fiance, and younger sister camped out in the waiting room, Kelly made slow progress. As her respiration improved and her sedation lightened, she became more responsive. She was taken off the jet respirator and placed on a regular one. Over the course of those four weeks, many of the unit's doctors and nurses seemed to develop a genuine affection for Kelly and her family. There was no thought in their minds of withholding any treatment from a young woman who seemed to be coming through so protracted a crisis.

Kelly's father Tom was optimistic but readily admitted that Kelly's illness had been an "emotional roller coaster" for him. There could come a time, he acknowledged, when he might say "enough is enough," but at the moment: "There is no decision to be made. I don't care what you have to do. You do what you have to to save her life. If you've got to cut the leg off to save her life, you are going to do it. That's the way I feel."

Late at night on the twenty-seventh day of her hospital stay, Kelly's heart stopped beating, probably a result of an infection acquired from one of the very lines used to sustain her life. Cardiopulmonary resuscitation along with heavy doses of drugs brought Kelly's heart back, but she was now unresponsive. As one of the interns said the next morning, she was now "a different patient."

After her arrest, Kelly's condition continued to worsen. "There's not much to say medically," one physician, Ken, acknowledged. "She's a train wreck.... Every single organ is in failure except the liver." With Kelly now unresponsive, Ken decided to press her family to make her DNR.

But Kelly's family would not agree. Tom understood that his daughter's condition had worsened. Still, as long as there remained any chance, he was not prepared to give up:

> As long as they do an EEG [an electroencephalogram] and they see brain waves, see, I don't care how sluggish they

> are. She can be retrained with a lot of time, energy, effort, and love.... So, until they tell me she's going to be a vegetable the rest of her life, you are going to put out 100 percent... And I'm going to fight for that...

In face of the family's insistence, Ken was willing to express his own ambivalence: "Maybe she's coming around. I'm not trying to be overly optimistic. She's young." The new doctors, who had rotated into the unit a week after Kelly's arrest and had never seen her when her eventual recovery seemed likely were less enthusiastic. "The father's bizarre," one intern claimed. "He's very accusatory of any suggestion that we're doing less than 100 percent."

Three and a half weeks after her arrest, on the fifty-fourth day of her hospitalization, Kelly developed a blockage in her lung. Ken immediately ruled out surgery as a possibility. He also ruled out a special type of dual ventilation: "To be honest, I'm not even going to present it to the family. We'll decide." But neither was Ken prepared to give up completely, especially given the family's wishes: "Her chances are low, but they exist. She still has a 5,6 percent chance of a six-month recovery.... And the family wants a full go."

Two days later Ken's resolve had hardened. He had talked to the family, he reported on morning rounds: "I think I finally got across to them that that's not their daughter anymore. It's not Kelly Connors any more. I'm going to be very tough with them and demand that she be made no CPR. Not withdraw care, just no CPR." But the family remained insistent on treating Kelly as aggressively as possible. Kelly died five days later, despite the best efforts of the staff to resuscitate her after her final arrest.

Questions for Conversation

1. How was decision making in Kelly Connor's case similar to that for Scranton Haskell? How was decision making in the two cases different? In which case do you think the decision making was more ethically acceptable? Explain your answer.

2. To what extent did Kelly Connor's family consider the physicians' technical expertise in making decisions about Kelly's care? Do you think they should have paid more attention to the doctors' advice? Why or why not?

PERSISTING QUESTIONS OF HISTORY

Creating a Decision-Making Continuum. Decisions about medical care can be made by the patient or the patient's family, by the physician, or by the two working together. On the two continua below, mark the line to indicate where you think authority for such decisions should be made. For example, if you think the patient and the physician should have equal voices, you would mark the center of the line. If you think the patient should make the decision but give heavy weight to the doctor's opinions, you would put your mark to the right of the center.

Decisions About How Aggressively Terminal Patients Should be Treated

Doctors should make decisions based on technical knowledge.	Patients or their families should make decisions based on own needs and values.

Decisions About Whether Specific Medical Procedures Should Be Used with Terminal Patients

Doctors should make decisions based on technical knowledge.	Patients or their families should make decisions based on own needs and values.

Now place an H on each line to show how you think the decisions were made in Scranton Haskell's case. Place a C on each line to show how you think the decisions were made in Kelly Connor's case. Does this exercise help you clarify your thinking about the two cases? What factors are not accounted for on the continua? An example might be age of the patient.

Expert vs. Citizen—Broader Issues. During a controversy over school governance in the 1960s, David Spencer, chair of a local school governing board in Harlem, argued that parents should have an important role in running the public schools. Spencer said: "People go to court

for their lives to go on trial, and we pick from the run of the mill to sit on the jury. There ain't but three people in the courtroom that know law. But yet we still put enough stock in those plain people to come up with a decision, by listening, thinking, using plain old common sense."

To what degree do you think "plain people," rather than experts or professionals, should be given power to make judgments in the following areas:

- Parents hiring and firing schoolteachers.
- Students planning their own courses in school.
- A citizens board reviewing police practices.
- Citizens planning cities (e.g., types of businesses allowed, building codes, facilities for education).
- Civilian control of national military strategy.
- Citizen's control over scientific research funded with tax dollars.

For each of the above matters, give an example of a specific decision that you think should be left up to a professional, technically trained person. Also give a specific decision that a layperson or nonprofessional should make.

Choices About Creating and Using Knowledge

Questions about creation and use of scientific knowledge confront people in many different situations. The cases below describe very different situations, but all involve creating or using scientific knowledge that affects people's everyday lives.

* * * * *

Federal Funding of Fetal Tissue Transplantation Research

During President Bush's administration, the federal government stopped funding medical research that involved using tissue from aborted fetuses. This decision was based on ethical concerns regarding abortion.

One of the first actions President Clinton took when he became president was removing this ban. His memo lifting the ban read:

> On March 22, 1988, the Assistant Secretary for Health and Human Services imposed a temporary moratorium on Federal funding of research involving transplantation of fetal tissue from induced abortions. Contrary to the recommendations of a National Institutes of Health advisory panel, on November 2, 1989, the Secretary of Health and Human Services extended the moratorium indefinitely. This moratorium has significantly hampered the development of possible treatments for individuals afflicted with serious diseases and disorders, such as Parkinson's disease, Alzheimer's disease, diabetes, and leukemia. Accordingly, I hereby direct that you [the Secretary of Health and Human Services] lift the moratorium.

Questions for Conversation

1. What factual claims did President Clinton use to support his action? How might you determine whether the claims are accurate?
2. Do you think Clinton's argument in support of his action is effective? Why or why not?
3. If you were President, would you support federal funding for fetal tissue research? Explain your answer.

The Doctor Who Said "No" to Smokers

People look to their doctors for help in solving health problems. But what should doctors do when patients don't use health information available to them? Dr. Mark Jameson of Hagerstown, Maryland, has taken a unique approach to this problem.

When Dr. Jameson set up a private practice early in 1993, he announced that he would not treat smokers. "People know when they smoke that it's adverse to their health. It's a voluntary act, but at the same time, it doesn't mean I have a duty to take care of them when they suffer from their deliberate act," said Dr. Jameson. "With Medicare and Medicaid, billions of dollars are paid by nonsmokers [for treatment of smoking-related illnesses]. Is that really ethical?"

Some people think Jameson's decision is a form of discrimination, similar to that practiced by doctors who do not want to treat AIDS patients. The members of the American Medical Association, including Jameson, agree to a policy stating that doctors cannot refuse to treat someone because of color, race, creed, sex, or other discriminating characteristics. Jameson agrees that he is obligated to provide emergency treatment for someone who is ill, whether smoker or nonsmoker. However, he sees follow-up medical care as a different issue. He believes he can refuse to provide such treatment for patients who refuse to "take responsibility for their health."

Questions for Conversation

1. What kinds of arguments does Jameson use to support his position? In your mind are these arguments persuasive? Why or why not?

2. How is Jameson's decision similar to and different from that of a doctor who prefers not to treat AIDS patients? Which decision is more ethically justifiable?

3. Do you think people have a responsibility to use the scientific information available to them? Explain your answer.

Junk Science and Juries

Imagine that you have been called for jury duty. When your name is called the day you report, the attorneys ask you several questions about your views on science. While you think scientific information is very valuable, you also believe that scientists can make mistakes. Your answers seem to satisfy the attorneys, and you are selected for the jury.

The case you are going to hear involves two children born with birth defects. Their parents' attorneys explain that they will present expert witnesses who will testify that the birth defects were caused by a morning-sickness drug taken by their mothers during pregnancy. Their experts have reanalyzed test data on the drug and have found that some birth defects do seem to be linked to the drug.

When the time for these witnesses to testify arrives, however, the drug company's lawyers object to the testimony, saying that because the information being presented has not been published in a refereed science journal, it is "junk science" and should be disallowed. (To be published in such a journal, an article must be favorably evaluated by others working in the same general field.) The judge, who thinks that experts will testify to anything if they are paid enough, agrees.

Without this information, the parents do not have much of a case. The jury votes in favor of the drug company, but you feel badly about the decision. The parents are appealing, saying that publication in a journal is not proof of "good science." Many bad studies have been published, while many groundbreaking studies have been rejected for many years.

Questions for Conversation

1. As a member of the jury, how would you feel about the judge's decision to exclude the expert testimony? Do you think the jury could have assessed the validity of the information for itself? Why or why not?

2. Do you think publication in a refereed journal is a sufficient criterion for deciding whether scientific information is valid? If not, what criteria would you suggest that courts—and citizens—use to decide whether to rely on scientific information in making decisions?

Persisting Issues of Modern Life

Reflecting on Critical Questions. You have read and discussed many cases related to the creation and use of scientific knowledge. For each of the central issues of this unit, write a brief summary of how the readings and discussions have contributed to your thinking on these questions:

- Under what conditions, if any, would it be in the public interest to prohibit or limit certain lines of investigation, to keep investigations secret, or to prevent a person from disseminating a scientific belief?
- Under what conditions, if any, might a scientist's obligations to his/her profession conflict with obligations to his/her country or to humankind? How should these dilemmas be resolved?
- What is the citizen's obligation to understand science? What kinds of public policy decisions, if any, should citizens delegate to scientists and experts?

Review, Reflection, and Research

Scientific Success and Choices

In an interview with Bill Moyers on the PBS program, "A World of Ideas," bioethicist Willard Gaylin said, "it's always our successes that get us in trouble, because successes give us choices." In what ways do you think this observation is correct? Which cases in this book tend to support Gaylin's view? Which cases, if any, tend not to support it?

Using current sources or your own science study, identify an area of scientific research that is experiencing "success." What difficult ethical choices might this success pose? Who, in your opinion, should make these choices—citizens, public officials, scientists? Give reasons for your decision.

Should Science Be Limited?

Many of the cases you have read in this book raised the issue: Under what conditions or for what reasons, if any, should pursuit or spreading of scientific information be limited? Below are some general rules dealing with this problem. To what extent do you agree with each of them and in what way would they help you to justify your opinion on the cases you have read?

a. People who advocate action, such as discriminating against a particular group, should be censored, because they can cause serious trouble. Beliefs about scientific subjects or descriptions of the world, however, can't do any harm, so they should not be censored.

b. Information about subjects on which scientists disagree should be censored. Once a theory has been proven absolutely true, it should never be censored.

c. If a belief, even a scientific one, goes against a person's religion, it would be reasonable to keep the belief from reaching those whom it would upset.

d. If a particular line of scientific research appears to a majority of citizens to have more potential for harm than good, limiting such research would be acceptable.

e. Knowledge is always valuable to someone. It is only the uses to which knowledge is put that can be evil. Thus, the pursuit of knowledge should never be limited.

Who Funds What Research

Today, limits on science may be due to lack of funds. At the 1992 Republican National Convention, Senator Phil Gramm of Texas proposed that a new test be used to decide what programs, including scientific research, should be funded. The test was called the Dickey Flatt Test. It involved calling Dickey Flatt, a store owner in Mexica, Texas, and asking him whether the program improves his life.

While the Dickey Flatt Test was undoubtedly presented in jest, the idea behind it raises serious questions. Many political leaders think that the federal government should only fund research that has immediate applications. During the presidential campaign, both President Clinton and Vice President Gore spoke about the need to put more science research money into projects that will serve clear national goals.

Such an attitude concerns scientists who do basic research, research that is intended to advance knowledge, without thought of applications. These scientists argue that our society is based on the notion that the pursuit of knowledge is important for its own sake. Walter Allmon, a paleontologist and evolutionary biologist, points to our system of public education and our support for the arts, which also do not have practical "utility," as evidence of this support. They also point out that basic research often has applications farther in the future.

While some people say that basic research can be funded by private concerns, this possiblity is not without problems. Industry, a major funder of research, is also concerned primarily with applications. Furthermore, industry funding may have "strings" attached. Math professor Marty Walters criticized Exxon after the *Valdez* oil spill in 1989, calling them "eco-terrorists and saboteurs." A company representative called the University of Colorado, where Walters teaches, and threatened to pull research money provided to Walters. In fact, Walters wasn't receiving any funding from Exxon, but the implications are clear.

If you were a member of Congress, what type of scientific research would you choose to fund? How would you balance applied research, which might solve important problems, and basic research, which could advance our understanding of the natural world without immediate tangi-

ble benefits? Develop a policy statement that explains what kind of research the government should fund and why.

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CONTENTS

The Public Issues Series . . . 1
The Necessary Questions . . . 1
Analyzing the Issues . . . 2
Teaching the Unit . . . 2
Preparing to Teach the Unit . . . 2
Introducing the Unit . . . 3
Society and Limits on Science . . . 3
The Scientist's Dilemma . . . 4
The Citizen's Role . . . 5
Today's Issues . . . 5
Review, Reflection, and Research . . . 5
Bibliography . . . 6
Student Handouts . . . 7

The Public Issues Series

The *Public Issues Series* was originally conceived of by the Harvard Social Studies Project of the 1960s and 1970s. The major purpose of the series—both then and now—is to help students analyze and discuss persisting human dilemmas related to public issues. We would emphasize that the term *public issues* is not synonymous with *current events*. By public issues, we mean problems or value dilemmas persisting throughout history and across cultures. The situations of Christian martyrs in Rome, a bureaucrat in Nazi Germany, a slave in 19th-century America, or an Ethiopian refugee in Texas in 1988 all represent important public issues. We believe that most of the important current events can be clarified by reference to public issues in other places and other times. Thus, all the units in the series suggest parallels between historical illustrations of persisting human dilemmas and present issues in the United States and the world.

The units in the series use historical, fictional, and contemporary situations. They also assist students in using a structured approach to issues analysis and in developing the skills of reasoned discussion. The units are not designed to be followed mechanistically through every question. There is no critical sequence of exercises. Teachers should view the materials provided as possible strategies for developing discussion of public issues and should pick and choose among the materials according to their own goals. In making selections, teachers should note that students will need information from other sources to discuss some questions intelligently; this may be a factor in deciding whether to have students address those particular questions.

As classes work with the materials, it is important to give students a sense of progress by periodically summarizing where the case material and discussion have taken them, particularly in terms of their discussion skills and the central, or necessary, questions of the unit.

The Necessary Questions

This unit on science and public policy focuses on the following organizing questions:

- Under what conditions, if any, would it be in the public interest to prohibit or limit certain

lines of investigation, to keep investigations secret, or to prevent a person from disseminating a scientific belief?

- Under what conditions, if any, might a scientist's obligations to his/her profession conflict with obligations to his/her country or to humankind? How should these dilemmas be resolved?
- What is the citizen's obligation to understand science? What kinds of public policy questions should citizens delegate to scientists and experts?

A variety of sources are used to acquaint students with how these questions have manifested themselves in various periods of history. Each of the three major sections of the unit presents two cases related to one of the critical questions. The first section uses the trial of Galileo and research on genetic links to violence to look at society's interest in placing limits on science. The second section examines ethical conflicts faced by scientists through the eyes of J. Robert Oppenheimer and a hypothetical scientist considering whether to use Nazi data. In the third section, controversies over fluoridation of drinking water, global warming, and decisions to end medical treatment of terminally ill patients provide a focus for considering when citizens should delegate decisions regarding technical matters. The "Today's Issues" section closes the unit with an examination of several current controversies—fetal tissue research, a doctor who refuses to treat smokers, and what scientific information should be admissable in court.

Analyzing the Issues

In addressing the necessary questions of the unit, students will grapple with ethical-value questions, definitional issues, and issues of fact-explanation. As students work through these issues, they should practice the explicit stating of issues and use of analogy to clarify their positions. The teacher's role in the discussion process is that of a questioner and clarifier. Another important teacher function is summarizing the progress students have made. Students may not readily perceive the ways in which their thinking has changed during a discussion, but a teacher synopsis of the questions examined and the strategies used to support positions can reinforce students' engagement in the discussion process.

Teaching the Unit

Each Public Issues unit can be taught in a variety of ways. The following is one way to approach *Science and Public Policy: Uses and Control of Knowledge*. The responses of your students to various materials presented in the unit, as well as the demands of your curriculum, may determine the questions or issues that you choose to stress.

Preparing to Teach the Unit. Post the examples of the three types of questions from page 5 of the unit on the chalkboard. Do not indicate which type of issue each represents.

Tell students that these questions represent three different kinds of issues that people must deal with in discussing public issues. Encourage students to come up with categories that describe the differences among the three kinds of questions. If necessary, provide an additional example of each type of question. For example: Is it moral to use fetal tissue in medical research? (Ethical or value issue) Will allowing use of fetal tissue in medical research result in increased abortions? (Fact-explanation issue) If use of fetal tissue is limited to research on serious diseases, what diseases would qualify as serious? (Definitional issue)

Students are not likely to come up with the names of the categories used here, but they should be able to describe such categories as "questions about what *should* or *ought* to be done," "questions about meanings," "questions about what happened or what would happen," and the like.

Explain to students that knowing how to categorize issues can be helpful because it helps identify the kinds of differences among discussants. If discussants understand the basis of the differences, they can better address those differences. With the students, construct a chart like the one on the next page, showing the different kinds of issues, their definitions, and strategies for dealing with each kind of issue. Be sure to spend some time with students discussing how analogies can be used.

Also discuss with students the frustration that can arise when you do not have all the information that you need to deal with a particular issue. This can be even more problematic when discussing highly technical matters, since students may feel they do not have the expertise needed to evaluate the data that is available. Encourage students to seek out the information needed and to develop criteria for evaluating information. Also point out, however, that if they cannot take time to gather more evidence, they can make a note of the information needed and use one of the following strategies to continue discussion: (1) the group may agree to stipulate a particular conclusion to the issue, or (2) the members of the group may agree to bypass or temporarily ignore the issue, using other arguments to make their cases. Also point out that when citizens do not have the knowledge needed to evalu-

Kind of Question	Definition	Strategies
Ethical or value	Questions that deal with judgments about what should or ought to be done—judgments about rightness or wrongness	Use of value-laden or "loaded" language Use of a respected or venerable source Prediction of a valued consequence Using an analogy—a similar case—to point out conflicting values and how they are weighed
Definitional	Questions about the meaning of an important word or phrase	Stipulation—agreeing to a particular definition Use of an authoritative source
Fact/explanation	Questions focusing on disagreements about the descriptions or explanations of events	Appealing to common knowledge or common sense Citing personal observations Referring to an authoritative source

ate technical positions, they must then look at the consequences of accepting the competing positions.

Share with students the first handout at the end of the unit, which provides tips for moving discussions forward.

Introducing the Unit. Ask each student to write down his/her definition of *science*. Then have students work in pairs to compare their definitions and try to reach consensus on a shared definition. If time allows, have the pairs form groups of four and repeat the process.

Distribute copies of the second handout at the end of the guide to students and ask them to compare this definition with their own. How would they change the list of qualities? What kinds of explanations do not fit these characteristics?

Next, assign students to read pages 3-5 of the unit. Conduct a brief discussion of the necessary questions of the unit, asking students if they can think of examples of current science issues that represent these questions. How do these questions relate to their definitions of *science*? Remind students to keep these questions in mind as they proceed through the unit.

Society and Limits on Science. The first reading in this section, "The Trial of Galileo," illustrates how a scientific theory (as contrasted with political dissent) can be perceived as threatening the stability of established institutions. Not until a speech by Pope John Paul II on October 31, 1992, did the Catholic Church completely rescind its condemnation of Galileo, a fact that contributed to the perception of the Church as rejecting scientific understanding. You may wish to point out to students that it was not only the Church that rejected Galileo's views; in fact, some other scientists sought the Church's help in opposing Galileo.

Another example students could consider would be the theory of evolution, especially as presented in public schools. Students could compare the famous Scopes trial in 1925 with the issues in the trial of Galileo. They might consider how religious views influence policy issues, even though in the United States religious groups do not have formalized political power.

Students tend to favor toleration of diverse ideas. However, the analogies of Dave Robertson and Hiram Lansing, presented in the "Persisting Questions of History" section, should elicit a willingness by students to consider certain limits on free inquiry and dissemination of its results. The problem is to identify criteria that will help one decide whether a particular form of inquiry or teaching should be censored. The case of Hiram Lansing may prompt students to consider what constitutes a *scientific* belief. The handout may again be helpful in pursuing such a discussion.

Another issue salient in the Galileo case is: How should heretics be treated? The class could explore the psychological and sociological implications of confession and public disavowal of beliefs, imprisonment, banishment, rehabilitation (e.g., through "education"), or absorption of the heretic and his/her views into the existing system.

The second case in this section deals with genetic research and its implications; the particulars of this case deal with attempts to identify genetic links with violent behavior. Some scientists argue that they are not responsible for the ways in which the knowledge they generate is used. You might use the following exchange from a Bill Moyers PBS interview of Maxine Singer, a geneticist who formerly worked at the National Institutes of Health, to stimulate student thinking on this issue:

Moyers: ...when engineers created ovens, I don't think they expected a Christian nation in the heart of Europe to put millions of human beings to death in them.

Singer: ...If the knowledge that is gained is misused, it is not because of science or the scientist, it is because of the same old human problems that have caused evil for eons.

Moyers: There's a will to use what we know.

Singer: ...whether evil uses technology that's new or technology that's old, what motivates it are human problems that have nothing to do with the developments in technology. To make technological and scientific development the scapegoat because it gives evil people new tools to do evil seems to be missing the boat.

If students have difficulty understanding why the genetics/violence link would be so controversial, you may need to provide some background information on the eugenics movement of the 1920s and 1930s. *Webster's* defines *eugenics* as "a science that deals with the improvement (as by control of human mating) of hereditary qualities of a race or breed." In the early part of the 20th century, eugenics was used as an argument to sterilize groups of people who, it was believed, would add bad genes to the gene pool.

Other scientists have also tried to suggest that what many regard as social problems are due to genetic differences among groups of people. For example, in 1969, psychologist Arthur Jensen published an article in the *Harvard Educational Review* claiming that differences between black and white Americans in performance on "intelligence" tests are caused primarily by genetics, not by home life, education, or other aspects of the environment. This research, whose validity was questioned by many scholars, created an uproar. Such historical uses of science to "demonstrate" the inferiority of a particular group of people cannot help but influence how people react to contemporary research, such as that on genetics and violence.

In the "Persisting Questions" section following the reading, students are asked to consider whether they would continue research on genetic causes of criminal behavior. They are also asked to consider which, if any, of several example applications of genetic research they would consider to be unethical or dangerous in any way. Encourage students to develop guidelines or criteria for making such decisions and then to apply the guidelines to other examples from science journals or the newspaper. If students have read *Jurassic Park* or seen the movie, they might consider whether their criteria could have prevented the disastrous events that occurred in the story.

The Scientist's Dilemma. The case of J. Robert Oppenheimer confronts students with the dual role of the scientist—as scholar and as advocate. The image of the ideal scholar has often assumed a dispassionate search for truth, but the scientist is human and therefore has personal beliefs and values that may influence his/her work. In addition, once a scientist has arrived at a scientific conclusion, he or she might, as a citizen, have to explain or advocate to others appropriate uses of that knowledge. How realistic or desirable is a dispassionate attitude? How extensive should a scientist's role be in advocating particular positions?

Since our version of the Oppenheimer case does not fully capture the political mood of the McCarthy era, you may wish to add information on the national concern for so-called security risks. In approaching the definition of *patriotism*, we can ask whether lack of loyalty should be inferred from Oppenheimer's personal associations and criticisms of the H-bomb, or whether he should have been considered "safe" until it was proven that he actually gave secrets to the enemy.

Students may sympathize with the AEC decision when the decision is considered in the context of the time involved. They may justify the AEC decision on the basis of the nation's need to stay ahead of a potential adversary in the arms race. Point out that threats to national security may not be limited to threats from abroad. For example, if unemployment grew so high that unemployed people rioted, should the government be able to dismiss without trial those who disapproved of its economic policy?

The second case in this section of the book deals with a scientist's dilemma in considering whether to use Nazi data to support a current study on hypothermia. The case presents the dilemma, followed by three differing views on what the scientist should do. As students are reading the case material, draw a line the length of the chalkboard, writing "Do not use the data" at one end and "Use the data" at the other end. Ask students to position themselves along the line to show their position on the issue. Explain that students can move along the line when they hear a convincing argument that persuades them to alter their views. Ask a student at one end to explain his/her position; then ask a student at the other end or in the middle to counter that position. Continue the discussion, encouraging students to question and respond to each other.

Following this "Voting with Your Feet" activity, which often encourages students with a more kinesthetic learning style to participate more fully in

discussion, turn students' attention to the analogy presented in the "Persisting Questions" following the case. Focus their attention on the question of what a scientist's primary obligation is—to science, to themselves, to their country, or to humankind? (Students may suggest other alternatives.)

The Citizen's Role. This section of the unit deals with the citizen's role in making decisions about technical matters. Students may find the community's resistance to fluoridation in "A Fight over Fluoridation" somewhat improbable. A more recent example is the public's reaction to information about the use of Alar, a reaction generally regarded as unfounded and deterimental to the livelihood of apple growers. A current example in which the disagreements among scientists are quite marked relates to global warming, which is taken up in the "Persisting Questions" following the fluoridation case. What can the citizen do when confronted with conflicting views on an issue that could have long-term negative effects?

The final reading in this section deals with the citizen's role in handling technical decisions at the personal level—in making decisions about health care, particularly when one is terminally ill. The cases presented in this reading illustrate not only the intellectual commitment of scientists (i.e., physicians) to citizen (i.e., patients) input in making decisions, but also the ways in which they circumvent this input when they are in the midst of what Robert Zussman calls "the culture of the ward."

An interesting accompaniment to this case might be the movie *Lorenzo's Oil*, which deals with a family's struggle to find a treatment for their son, suffering from ALD. In the movie, the scientist's need to adhere to a research protocol is depicted as standing in the way of finding a treatment for the individual patient, who indeed does better than expected when his parents succeed in getting him an experimental treatment. Follow up the movie with a discussion of this conflict between institutional science and the individual. Ask students whether their views are changed by the fact that clinical trials with the treatment have shown that it is *not* effective with all ALD patients.

Following the reading, students are asked to consider whether they think "plain people" should be allowed to make decisions in a variety of areas. Help students analyze whether they are more likely to cede decision-making power to professionals in some fields (e.g., science) than in others (e.g., education)? If so, why?

Today's Issues. This section contains three brief cases that involve all of the unit's critical questions. You may want to divide the class into three groups and assign one case to each group. The groups could then do additional reading on their assigned issues and make presentations to the class. The "Persisting Questions" at the end of the cases asks students to reflect on how the readings and discussion in this unit have shaped their thinking related to the critical questions.

Review, Reflection, and Research. These exercises include writing, research, and discussion. You may assign them selectively for completion by individual students or small groups, or they can be used as topics for large-group discussion and reflection on the unit. They can also be used for evaluation purposes.

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Student Name_____

MOVING DISCUSSION FORWARD

People often begin a controversial discussion with spirit and excitement. Then, after a short time, they come to feel that the discussion is bogged down, or simply going in circles. One reason for this may be the assumption that the *only* purpose of discussion is to resolve a disagreement. But it is often just as useful and exciting for people to learn more precisely just where and how they disagree.

Here are some suggestions for making discussion clearer, and for resolving smaller disagreements that may sidetrack the larger discussion.

1. **Working toward an agenda**. An *agenda* is a list of issues that a group agrees to consider in the course of a conference or discussion. When a group begins discussing a complicated situation, different people see different issues. Each usually talks about the issue he or she thinks most important. Participants may be *insensitive* to the issues that others see. One way of dealing with this problem is to list all the issues that seem important. The participants in the discussion then decide which issues they wish to discuss, and in what order.

Having made this decision, members of the group can remind one another of what points are relevant and what points are not. If someone jumps to the third issue when the group is still entangled in the first, he/she can be reminded that his/her contribution is not relevant at this point.

2. **Stipulation.** What happens when members of a group begin to see clearly that there are factual points in a discussion where they cannot possibly reach agreement because of the lack of available evidence? Under these circumstances it is sometimes possible to stipulate that a controversial claim is true. This is done for the sake of exploring the implications that will follow.

3. **Concession.** Perhaps the hardest thing for a person to do in an argument is to admit that a point he or she is defending is weak or needs to be modified. If one looks at discussion as a place to test one's point of view and to distinguish between justifiable and unjustifiable claims, it is reasonable to discard or concede those ideas that do not hold up. It is reasonable to *qualify* those claims that are too broad and sweeping. Concession and qualification are not simply signs that a discussant has "lost" a point; they are also signs that the participant is reasonable and sensitive to evidence.

4. **Summarizing the trend.** Discussions that include several participants dealing with a controversial problem can quickly become confused and confusing. Issues may be raised, dropped, and raised again. Some points may be conceded. Facts and definitions may be stipulated. Claims may be refuted, only to appear again at another point. For this reason it is important to ask frequently, "Where has the discussion come, and where is it going?" and to summarize clearly the state of affairs. It is a good idea to take notes (with the help of a chalkboard or overhead projector) to outline the major issues. Discussions that revolve around unrelated fragments are most likely to go nowhere.

Student Name_____

WHAT MAKES AN EXPLANATION SCIENTIFIC?

Science has been defined as a way of developing answers, or improving explanations, for observations or events in the natural world. Yet poets, philosophers, and theologians also develop explanations for natural phenomena. What differentiates a scientific explanation from an explanation that is not scientific?

Some students of science say that to be scientific, an explanation must have the following characteristics:

- It must be based on empirical observations or experiments.
- It must be made public.
- It must be tentative. A better explanation may always be developed later to replace it.
- It must be historic; that is, it must account for earlier explanations.
- It must be probabilistic. If an explanation is stated in absolute terms, it is not scientific. Instead, it should be stated in statistical terms.
- It must assume a cause-effect relationship and make distinctions between causality, correlation, coincidence, and contingency.

Do you agree that these are the qualities of scientific explanations? Would you make any additions or deletions? Why? Can you think of explanations that do not fit these characteristics? How would you classify these explanations?